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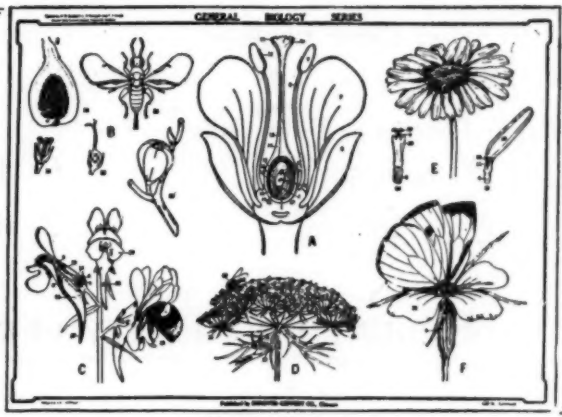

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THE SCHEME WORKER

THE establishment of the Imperial (now Indian) Council of Agricultural Research in the thirties marked the realisation of the grave backwardness of Indian agriculture and the lack of systematic effort at tackling problems peculiar to the indigenous plant-industry. The Council of Scientific and Industrial Research was its counterpart, started during the war, to answer the growing needs of Indian industry. The Indian Research Fund Association, a similar body dealing with the health and nutrition of the people, has been in existence for a much longer period.

These organisations sort out and allot for solution specific problems, in the form of *Schemes of Investigation*, to qualified men to be worked out either in the Council's or other laboratories in the country—all, on the advice of experts in the respective fields. The Scheme Worker can be defined as a trained worker with a set problem, determined to find a solution in a limited period of time, and receiving emoluments generally more than a stipendiary and less than a permanent staff member. Such employment of workers, as conditions of service now stand, involves no obligation on the part of the Councils to ensure continuity and security of employment to the workers, irrespective of the outcome of investigations entrusted to them. This is, to say the least, hard on the workers. In such an atmosphere the worker will have to be either on the look out for fresh problems for *schemes* that "appeal" to the Councils or for permanent posts which he must need secure before he exceeds the official age bar. This state of constant anxiety, it will be appreciated, is not exactly conducive to high morale resulting in the best output—either in quality or quanity—of scientific research. For, the most successful and lasting solutions and discoveries have got to be backed by years of concentration on specialised fields of investigation. The hunt for new schemes and lucrative employment in any field, on the other hand, cannot but fritter away the enthusiasm and collected experience of young scientists who would, given the chance, willingly work for Science and Country. Instances are common of promising workers who had to enter into routine non-technical professions

merely for want of encouraging scope in *schemes*—a waste we could ill-afford at the moment. By this, we should not, however, like to be taken to imply that this system has not been a success. On the contrary, it has to its credit the large success of the war effort and many an innovation and invention useful for improvements in agriculture, dairying, industry, health and epidemiology. But we should like to emphasise that the success has been in spite of the none-too encouraging rewards from the promising results of schemes.

It must, however, be said for the Indian Councils that the funds at their command have not been so munificent and their experience so ripe as to expect flawless organisation and administration in these matters. So far, they have been more or less makeshift arrangements. But it is now quite clear that each of these Councils—and more that are to come—need a standing army of trained scientists each with a specific branch of applied science for his life-work. If we are, therefore, to expect efficiency and loyalty from those who would devote themselves to fruitful careers of scientific research in the service of the Councils—and, therefore, ultimately of the nation—we cannot grudge security of employment and fair wages in return.

To plead in this strain for the Scheme Workers is not to invite the Councils to offer every entrant a sinecure. For, we admit, it is not given to every college graduate to become a successful scientist endowed with an analytical research mentality, no more than for every paint-dauber to become an accomplished artist. The *scheme* will, therefore, have its place as a period of training and trial under a critical teacher. And this period could be reckoned as a continuation of the academic training of the candidate. But, having sifted the grain from chaff, fair and encouraging conditions of service must be offered to the worker.

We may venture to suggest that this is a subject that could be taken up by the newly formed Association of Scientific Workers with the Councils of Research. We have reason to hope that the Government will, both in the interest of rapid development of the country and of justice to the Scheme Worker, generously treat the scientists, on whose contentment and enthusiasm depends to a degree the pace of material progress of the nation.

INDIAN SCHOOL OF MINES—EXPANSION

THE Indian School of Mines, Dhanbad, is to be called, hereafter, the Indian School of Mines and Applied Geology. Steps towards its re-organisation have been recommended by the Committee appointed by the Government of India in a report, which has been just published.

The Committee has formulated proposals for the extension of the activities of the School, for an increase in the annual intake of students and generally for raising the School to the standard of the Royal School of Mines, London.

Recognising the increasing demand for mining engineers and geologists in the country the Committee recommends that the annual intake of the School should be increased gradually from the present total of 24 to 60, consisting of 48 mining and 12 geology students. Admission will continue to be through an entrance examination, and candidates at this test should have taken physics and chemistry at the Intermediate or equivalent examination. The Committee recommends also the abolition of the three-year certificate course, as a result of which all entrants will be required to take the full four-year course leading to the granting of the Diploma in either Mining Engineering or Geology.

Revision of Curricula Suggested

The Sub-Committee appointed for the revision of curricula has made special recommendations in which they insist that subjects like fuel technology, oil technology, refractories and ceramics, metallurgy, and geophysical prospecting should be given greater attention hereafter. It has pointed out that as in the Royal School of Mines, London, greater emphasis should be laid on geology in teaching mining.

The Committee has proposed a scheme of post-graduate training to enable the graduates of the School to pass the competency examinations prescribed under the regulations. This scheme is estimated to cost Rs. 2·63 lakhs per year, a sum which, it is urged, should be shared equally by Government and the Industry.

The need for increased association between the School and the Industry has been emphasised by the Committee who suggest that the mining associations should provide endowments in the School, and also that representatives of the Industry should be associated with its Governing Body in greater strength than at present.

Interim action on the lines of the recommendations of the Reorganisation Committee has been initiated by the Works, Mines and Powers Department (India) sometime ago, and some of the additional accommodation that will be necessary for the School in its expanded phase are already under construction.

A SURVEY OF VARIOUS ELECTRIC SMELTING PROCESSES AND THEIR APPLICATION TO INDIA—PART I

HERMAN CHRISTIANSEN

(Engineer, Elektrokemisk A/S, Oslo, Norway)

NATURE has endowed India with an unusually large share of the mineral resources of the world. Iron ore, bauxite and manganese ore are available in practically unlimited quantities. Chrome, tungsten, vanadium, ilmenite and other ores are likewise plentiful, and there are abundant deposits of limestone.

So far, only a limited advantage has been taken of this wealth, but the growing industrialisation of India will undoubtedly call for an increased utilization of its mineral resources.

In this future development, the electric furnace is bound to play an important part, as the majority of ores and minerals are processed exclusively by electro-thermic or electrochemical means. The very favourable possibilities for inexpensive generation of hydro-electric power give India an advantageous position in the field.

Iron and manganese ore may, of course, be smelted in the common blast furnace, but the introduction of the electric smelting process would preserve the Indian coal and charcoal resources. In view of the scarcity of domestic coal supplies in many localities—at least coking coal—this process would be of great national importance. From an economical point of view, the question of blast furnace *versus* electric furnace depends mainly on the relative cost of coal and electric energy.

The Electric Furnace

The electric reduction process is usually carried out in a low-shaft furnace of simple design, the heat required to maintain the smelting temperature being mainly generated by the resistance of the charge to the electric current which flows between the electrodes.

The principle of a typical electric smelting furnace, as used for the production of ferro-silicon, for instance, is shown in Fig. 1. The voltage of the incoming high tension current is stepped down to operating voltage in one or more furnace transformers (*t*), located in the near vicinity of the furnace. From the transformer, the current is carried to the electrode (*e*) through interleaved heavy copper bus bars, copper tubes and cables. Contact with the electrode is ensured by means of water-cooled clamps.

The electrodes were previously of the pre-baked type, which frequently had to be renewed at the expense of labour and breaks in production, but in the early twentieth century the Søderberg continuous self-baking electrode came into general use. This electrode, which is illustrated by Fig. 1, is prepared at site and baked by waste furnace heat. In principle it

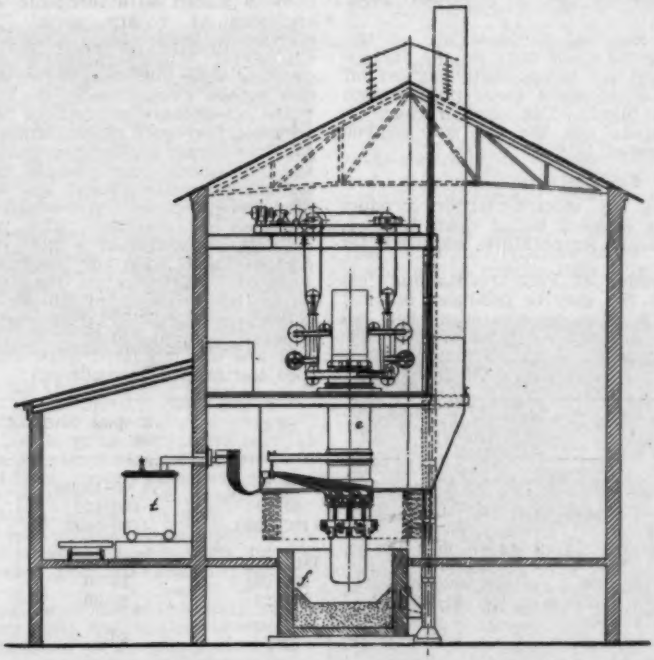

FIG. 1. Section through smelting plant.

consists of a steel sheet casing, filled with electrode paste. As the electrode is consumed in the smelting process the top end is extended by welding on new sections of electrode casing and re-filling paste. This electrode is now widely used in the smelting industry, and has been described in detail in various technical literature.

The furnace body (*f*) consists of a steel shell, lined internally with heat-resisting brick and rammed carbon/tar paste.

The molten product is tapped through one or more tap-holes into tapping pans or ladles, and is crushed after cooling.

The electric smelting furnace may be equipped with up to three electrodes (in special cases even six), but it is now almost unanimously accepted that the three-phase furnace is to be preferred for high loads, i.e., from about 4,000 kW and upwards. In smaller furnaces it may be desired to use one electrode only, for greater simplicity of design and operation. Two such single-phase furnaces may be coupled in Scott to give a uniform load on a three-phase power distribution line.

Owing to the rectangular shape of the pre-baked electrodes used, these were originally placed in line, but the more recent practice is to arrange the electrodes in an equilateral triangle in order to obtain electrical symmetry.

Most electric smelting furnaces are of the open type, where the gases burn on the surface of the charge, and are subsequently sucked off through stacks, or in some cases put through a dust removal plant. The open furnace is simple in operation, but the CO gas evolved is, of course, wasted.

Ferrosilicon

Ferrosilicon is an electro-thermic product which is usually smelted in an open furnace, owing to the high temperature required for ore reduction.

The lower grades of FeSi (containing less than 20 per cent. Si) may be produced in blast furnaces from silica-rich iron ores, but all other grades are smelted exclusively in electric furnaces. The process is simple, and consists of the reduction of quartz by coke, anthracite or charcoal. Scrap-iron is used when necessary, to obtain the desired Si-content.

The quartz should be as pure as possible (96-99 per cent. SiO_2) and free from impurities which may cause slag formation or appear in too large quantities in the tapped product. This is, of course, of primary importance when producing silicon metal. There are no special requirements as to the quality of the coke, and even coke breeze is employed to a very large extent.

However, when producing alloys containing 90 per cent. or more silicon, the coke must obviously have a low enough iron content to ensure that the desired metal quality is obtained. In the production of silicon metal it is necessary to use charcoal or petrol coke, in order to limit the iron and alumina content of the charge to a minimum.

Owing to the high melting point of the raw materials used, and in the case of high grade FeSi and also alloy, the primary object in the ferrosilicon furnaces is to obtain the greatest possible concentration of heat in the smelting zone. This may be accomplished by operating with a high current density in the electrodes.

Furnaces for the production of 45-50 per cent. and 75-80 per cent. ferrosilicon are generally built in capacities up to 8-9,000 kVA, whereas for silicon metal, 5,000 kVA may be considered a large unit.

The latest improvement in electric furnace design, the rotating hearth furnace, has found its first application in the production of ferrosilicon. According to this design the furnace body is placed on a turntable which rotates or oscillates at a low speed. The electrodes, suspended vertically at three points of an equilateral triangle, remain stationary. The smelting zone will thus move sideways in relation to the electrodes.

The advantages claimed for this furnace type are that the smelting conditions are improved, as the charge is kept porous by the motion, and the gases may escape freely. "Bridge" formations and explosive gas eruptions, which may sometimes be experienced in a stationary furnace, are reduced. The power and raw material consumption is also stated to be decreased, and wear on hearth and lining is reduced. Furthermore, the furnace pot may easily be cleaned out during shut-downs, or when a change-over from one product to another is contemplated.[1]

Below are tabulated some operational figures (per ton tapped ferrosilicon)

Ferrosilicon Operating Data

FeSi grade	45%	75%	90%	Si-metal
Power consumption, kWh ..	5000–6000	9000–11000	12 00–15000	18000–2200)
Electrodes, kgs ..	30–40	60–70	100–120	150–180
Coke, kgs ..	550–650	1100–1200	1400–1600	..
Charcoal kgs ..	..	..	..	2000–2200
Quartz, kgs ..	900–1100	1800–2000	2300–2000	3000–4000
Scrap iron, kgs ..	500–600	200–250	10–30	..
Man hours (furnace operation and tapping only)	10–12	15–20	23–30	40–50
Silicon yield %	90	85	80	60–65

for various qualities of ferrosilicon. The better figures refer to modern installations with Søderberg electrodes.

1. Ellefsen, T., "The ELKEM Rotating Hearth Furnace for Electrothermic Process," The Electrochemical Society, 1946.

It should be noted that the figures are based on normal operating conditions, and that they are subject to considerable variations according to quality of raw materials, efficiency of labour and operation, etc.

FIG. 2. 15,000 kW carbide furnace.

FIG. 3. 10,000 kVA ferro alloy furnace.

CALCIUM CARBIDE

Calcium carbide is prepared exclusively in the electric furnace, lime being reduced by a carbonaceous material under high temperature (2,000-2,200° C.), according to the equation:

$$CaO + 3\ C = CaC_2 + CO.$$

Commercial grade carbide which according to international specification should yield 280-300 litres of acetylene, contains some 80-82 per cent. CaC_2.

The lime should be of the best quality available (96-98 per cent. CaO), and particular attention must be paid to its physical characteristics. The most common reducing agents employed are coke and anthracite. In connection with high grade lime, bituminous coal may also be used in open furnaces. Charcoal is normally too expensive, but is otherwise an excellent reducing agent, which will produce a pure carbide. Charcoal of the heavy tropical type is especially suitable. It is most essential that the raw materials are correctly sized, and too high a moisture content in the reduction materials should be avoided, as otherwise the lime will be slaked after the charge has been mixed.

Carbide is produced in electric furnaces constructed on the same principle as those employed for ferrosilicon, but much larger units have been built in the endeavour to obtain increased production and reduced production costs. The transformer capacities may vary from about 3,000 kVA to as much as 40,000 kVA. The greater number of carbide furnaces in the world are still of the open type, but, semi-closed and closed furnaces are also much used. The semi-closed type has found particular application in many of the modern carbide works in Germany.

These furnaces are usually rectangular, with three oblong electrodes connected in line. The electrodes were previously made up of four to six blocks of pre-baked carbon sections, but even before the war they had been to a great extent exchanged for oblong Søderberg electrodes. "Bridges" of water-cooled pipes covered with a heat-resisting material are arranged between the electrodes, and also between the end electrodes and the furnace wall. The purpose of the bridges is to improve working conditions for the furnace operators, and to collect some of the furnace gases which may then be sucked off through a stack, or passed through a gas-cleaning plant.

The gas may contain as much as 55-65 per cent. CO, and some 35-40 per cent of the amount evolved may be collected.

Entirely closed carbide furnaces, equipped with electrodes in triangle, have been in operation in the United States for a number of years. The furnace cover is usually constructed of water-cooled, alloy steel sections. Around each electrode is a hopper, fed with raw material mixture from overhead bins. According to reports, this type of furnace operates very satisfactorily, but it is dependent on a mixture feed containing little or no fines, as the small particles would prevent the passage of gases, and thus cause "blowings".

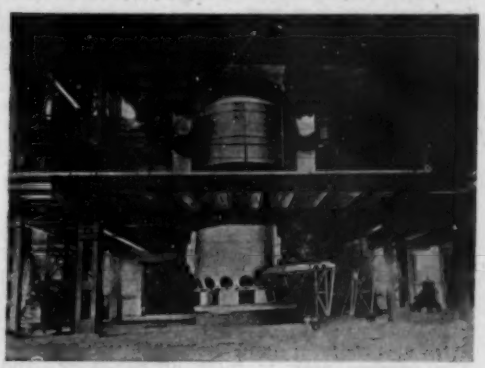

FIG. 4. 6,000 kW rotating hearth furnace.

Closed carbide furnaces as designed by Elektrokemisk A/S, Oslo, Norway, are now also being introduced on the principle of the Tysland-Hole furnace (see next chapter). According to this design the charge is fed to the furnace through water-cooled shafts, located at a distance from the electrodes, the advantage being that the evolved gases are permitted to escape more freely, and operation is far less dependent on the physical qualities of the raw materials.

Closed furnaces are generally more economical in operation than open furnaces, and the working conditions for the furnace crew are greatly improved. The furnace gas is, furthermore, a valuable by-product, and may be used for heating, chemical synthesis or other purposes.

Below is given a table of operating data for carbide furnaces, the better figures relating to large furnaces. Operating conditions and quality of raw materials are assumed to be normal.

Calcium Carbide Operating Data

	(Per ton 300 ltr. carbide)
Lime (96–98% CaO), kgs	900–1000
Coke (10–12% ash), kgs	600–650
Power, kWh ..	2900–3600
Man hours (furnace operation and tapping only)	2–7
Electrodes, kgs ..	10–30

Calcium carbide was previously used almost exclusively for welding and lighting purposes, but an ever-increasing amount is now being absorbed by the chemical industries.

Pig Iron

The electric furnace is also widely used for the production of pig iron. It finds its main application in regions where good quality coke is scarce, and hydro-electric power available at comparatively low cost.

Electric smelting of iron ores was first introduced in the beginning of the twentieth century, with the Swedish "Elektrometall" furnace.

This furnace, which was only designed for the use of charcoal as a reducing agent, has since been superseded by the Tysland-Hole furnace, the first commercially successful electric pig iron furnace also to be adapted to the use of coke.

The Tysland-Hole furnace is a low-shaft, closed electric furnace, which can operate with almost any kind of reduction materials, and which is generally much less dependent on the high physical strength of the raw materials than the blast furnace.

The furnace is equipped with three Søderberg electrodes, usually arranged in triangle. The furnace arch is built of fire-brick, and rests on water-cooled steel beams. The charging system, by which the raw materials are fed to the furnace at a distance from the electrodes, is of particular interest.

The main advantage of this system is, as mentioned before, that furnace operation is far less sensitive to fines in the charge, than with other closed furnaces.

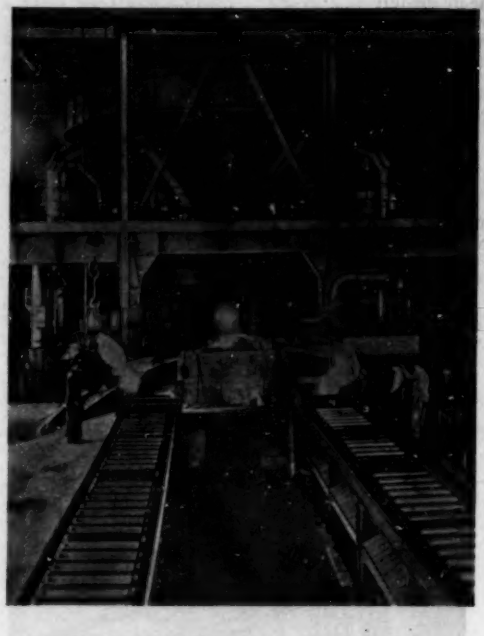

FIG. 5. 7,500 kVA Tysland-Hole furnace.

Owing to the high slag temperature in the electric furnace, exceptionally good desulphurization may be obtained.

The furnace gas is a valuable by-product, which may be used for chemical synthesis, sintering of fine ores, heating or other purposes. Some 650 Nm^3 of gas is produced per ton pig iron, the calorific value being about 2,500 kCal/Nm^3. A typical gas analysis is as follows:

Gas constituent	Volume %
CO_2	15
CO	72
C_mH_n	3
H_2	8
N_2	2

As the gas usually contains a certain amount of dust, it is purified in a gas-cleaning plant before entering the distribution line.

The Tysland-Hole furnace can be operated on 50 per cent. of the normal load, without any disturbances or unreasonable increase in the consumption figures.

The furnace is usually built in two standard sizes, viz., 7,500 and 13,200 kVA capacity, corresponding to a daily output of approximately 50 and 90-100 metric tons of pig iron respectively. A larger unit of 24,000 kVA, with an

estimated daily capacity of 200 tons, has also been designed, and three or four of these units will be erected for the new iron and steel plant which is being built by the Norwegian Government.

Below are tabulated some operational figures for Tysland-Hole furnaces. The figures are based on a burden giving 50-55 per cent. pig iron with a Si-content of 1-2 per cent., under normal operating conditions.

Tysland-Hole Furnace. Operating Data

Transformer capacity kVA	7,500	13,200
Normal operating load, kW	6000–6500	10000–11000
Annual production, M. tons	17000–20000	30000–33000
Labour (entire staff included) man hours per ton		
For one furnace ..	5	3
For two furnaces ..	3·5	2

	Per metric ton of pig iron
Slag produced, kgs ..	350–500
Gas produced, Nm^3 ..	650–700
Ore, kgs ..	1500–1700
Limestone, kgs	300–400
Reducing agent, kgs (coke, coke breeze, anthracite charcoal, etc., 10–15% ash)	375–450
Electric power, kWh ..	2400–2600 (*)
Electrodes, kgs ..	8–15

* Under favourable conditions, the power consumption may be as low as 2200 kWh. If foundry pig iron containing 2–3% Si is produced, the kWh-consumption will increase to about 2600–3000 kWh per metric ton.

Ferromanganese

The most important manganese alloy is standard ferromanganese, containing 78–82 per cent. Mn and 6–8 per cent. C. Other commercial grades are "Spliegeleisen" (15–30 per cent. Mn) and silico manganese, containing approximately 25 per cent. Si, 55–70 per cent. Mn and less than ·5 per cent. C. Low carbon ferromanganese and manganese metal is also produced for special purposes.

Standard ferromanganese may be produced either in the blast furnace, or electrically. Electric furnaces have found application in regions where the cost of power is low, and where coal of a quality suitable for blast furnace use is scarce. The process is simple, comprising the reduction of manganese ore by coke, under high furnace temperature. Limestone is added for slag formation.

In order to obtain satisfactory, economical operation, rich manganese ore should be used 50% Mn), but low grade ores (35-45% Mn) may also be employed, provided the silica content is not excessive (below 10%). In contrast to the blast furnace, electric production of ferromanganese may also be accomplished with inferior quality reduction materials. Coke breeze is a common and inexpensive reducing agent, and charcoal or anthracite may also well be used.

Owing to the fact that manganese is easily volatilized, it is essential to keep the operating temperature as low as possible, in order to reduce evaporation. For this reason, comparatively large electrodes with a low current density are used, and closed furnaces are employed to a certain extent.

The American type furnace, as previously described, is much used, but ferromanganese is now also smelted successfully in the Tysland-Hole furnace. Capacities may vary from 2,000 to 15,000 kVA, the larger units being more economical in operation.

The following table gives various operational figures for ferromanganese furnaces. The figures are based on normal operating conditions.

Ferromanganese Operating Data

Analysis: 78–82% Mn, 6–8% C	(Per ton tapped product)
Power consumption, kWh ..	2500–3500
Manganese ore, kgs (50% Mn, 7% SiO_2) ..	1800–2000
Limestone, kgs ..	450–600
Coke (10–15% ash), kgs ..	550–650
Electrodes, kgs ..	15–25
Man hours (furnace operation and tapping only) ..	4–5
Manganese yield % (approx.) ..	80–90

Ferrochrome

Ferrochromium containing more than 4 per cent. C is produced in the electric furnace without any serious difficulties, through the direct reduction of chrome ore (48-50 per cent. Cr_2O_3) by a carbonaceous agent. Working with a surplus of ore, and using firebrick lining for the furnace instead of carbon, the carbon content may be reduced to approximately 1 per cent., although the chromium yield will thereby decrease.

Low carbon ferrochrome (0·5-0·4% C) used to be produced alumino-thermically. But reduction in the electric furnace by means of a two or three-step process is the accepted modern method. The French Moutiers process for the production of ferro alloys low in carbon, is also used with success in the manufacture of L.C. ferrochrome.

Ferrochrome Operating Data

(Analysis: 4–6% C and 68–72% Cr)	(Per ton FeCr)
Power consumption kWh ..	5000–6000
Ore (50% Cr_2O_3), kgs ..	approx. 2200
Quartz, kgs ..	,, 300
Coke (10–15% ash), kgs ..	,, 600
Electrodes, kgs ..	50–60
Chromium yield, % ..	90–95

The electric furnace is also employed in the production of a number of other ferro alloys, such as ferrotungsten, ferromolubdenum, ferro-

zirconium, etc. These processes are generally carried out on a much smaller scale than those already described, and it should not be necessary to go into details. There is, however, a growing interest in these more "rare" elements, and the future will no doubt also bring improved and rationalized methods of production.

The possibilities for large-scale expansion of the metallurgical industry in India are almost inexhaustible. A good start has already been made by the proposed plans for increased production of iron and steel by the electric process. Carbide and ferro alloy furnaces are also under consideration. Furthermore, projects have been drawn up for several large hydro-electric power plants, and many districts are favourably situated with regard to further harnessing of water power.

The Indian industry should, therefore, be in a position to attain a high standing in the electrometallurgical field.

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AN ACCURATE PRESSURE GAUGE EMPLOYING MEASUREMENT OF SURFACE STRAIN ON DIAPHRAGMS

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THE simplicity and accuracy with which surface stresses can be measured by means of bonded wire strain-gauges prompted us to investigate whether the measurement of surface-strains produced on diaphragms (as distinct from the customary deflexion measurements) could be adapted to accurate measurement of high pressure. The preliminary results obtained in this investigation are set out here and it can be seen from these results that the method proposed is indeed capable of high accuracy.

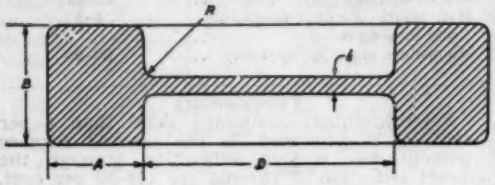

FIG. 1

As plain discs, clamped at the edge, did not yield reproducible results, diaphragms with integral holding-rims and appropriate fillet radii, as shown in Fig. 1, were employed. These were accurately machined out of thick plates of spring steel, clamped at the rim in high pressure unions and work-hardened *in situ* by subjecting them repeatedly to cycles of high and low pressures. The dimensions of the diaphragms employed and their maximum service pressures are given in Table I.

Two well matched strain-gauges (Tinsley's) each of about 200 ohms resistance, were mounted with Durofix, one almost centrally on the diaphragm to measure the strain and the other on the union-nut to compensate for variations in ambient temperature. The variations in the resistance were measured to within 4×10^{-4} ohms with a direct-current bridge of the Callendar-Griffith type, using as null indicator a Moll reflection galvanometer of high sensitivity. With this equipment surface strains could be measured correct to ± 1 micro-inch per inch.

As reference gauge a Budenberg Standard Test gauge with ten-inch dial and reading up to 2,000 lb. per sq. in. was employed. The

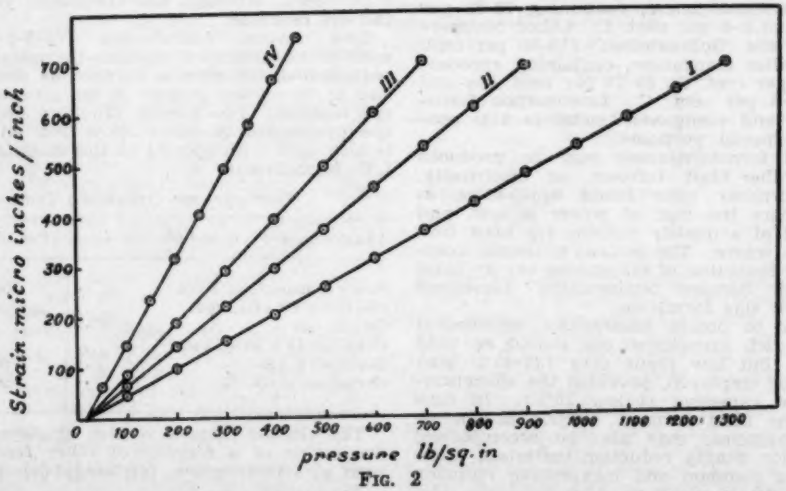

FIG. 2

pointer of this gauge was set by the makers to read the absolute pressures directly on the dial. The gauge calibrations were checked with a dead-weight tester and were found to be correct to ±1 lb. per sq. in. up to 1,500 lb. per sq. in.

TABLE I

Dimensions of the diaphragms and their maximum service pressures

Diaphragm No.	I	II	III	IV
Thickness over flat portion (t in.)	0·0945	0·0735	0·0640	0·0420
Diameter of diaphragm (D in.)	1·250	1·226	1·250	1·25
Fillet radius (R in.)	0·04	0·05	0·06	0·15
Radius of flat portion (D/2 − R)	0·585	0·563	0·565	0·475
Width of rim (A in.)	0·21	0·22	0·21	0·21
Thickness of rim (B in.)	0·20	0·19	0·18	0·25
Maximum Service Pressure (lb./sq. in.)	1300	900	700	450

The results obtained are shown graphically in Fig. 2. In each case, the plot of strain *vs.* pressure gave a straight line. Within the limits of maximum service pressures given in Table I, the diaphragms were perfectly elastic and responded to rising and falling pressures without lag and without hysteresis or creep. The pressure *vs.* strain calibrations were remarkably stable and the slope of strain to pressure was maintained even after the diaphragms had been dismantled and reassembled.

Table II shows a typical set of data obtained in four calibrations with Diaphragm III, on which a strain-increase of 1μ in./in. corresponds nearly to an increase 1 lb./sq. in. in the pressure. It is evident from the table that the largest average deviation from the mean values is 1·25; i.e., 1/6 per cent. of the full range value of 706μ in./in. Even towards the lower end of the scale (*e.g.*, 100 lb./sq. in.) the average error is less than ½ per cent. of the mean value for that pressure, but less than 1/11 per cent. of the full-scale value.

TABLE II

Results obtained with diaphragm III in four runs

Pressure lb./sq. in.	Strain in μ in./in.					Average deviation from the mean	Percentage $\frac{\text{Av. Devn.}}{\text{Av. strain}}$
	1	2	3	4	Mean		
13·4	0	0	0	0	0	..	..
100	86	86	85	86	85·7	0·4	0·46
200	189	189	187·5	187·5	188·3	0·7	0·37
300	291	290	290	290	290·3	0·4	0·14
400	394	395	394	395	394·5	0·5	0·13
500	499	499	496·5	496·5	497·8	1·25	0·25
600	601·5	603	600·5	601·5	601·6	0·68	0·11
700	706	706	7·6	706	706	0·00	0·00

Apart from the accuracy, the method suggested above carries with it, all the advantages common to electrical methods, such as adaptability for remote control, wide choice of accessory apparatus, interchangeability of components, etc.

The variation of strain with pressure is being further examined.

Our sincere thanks are due to Prof. B. C. Carter, Head of the Department of Internal Combustion Engineering, for many helpful suggestions.

METALLOGENETIC EPOCHS IN INDIA

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CERTAIN relations between the formation of ore-deposits and other geological processes are now generally accepted, namely, that many metal deposits are closely associated with igneous activity, that igneous activity occurs in belts of strong folding and faulting in orogenic belts, and that ore depositions have been repeated through geological time resulting in rather definite periods in which metalliferous deposits have formed. These periods of metal deposition are known as metallogenetic epochs.

In Europe, four systems of folding or orogenic periods have been recognized, namely, Huronian (or Charnian), Caledonian, Hercynian and Alpine. Most of the metal deposits there result from igneous activity related to these periods of folding and faulting.

The Huronian movement is mainly confined to the great shield of Fenno-Scandia, to Sweden, Norway and Finland. The deposits carry mainly iron and copper. The rich magnetite deposit at Kirunavaara associated with a syenite porphyry is believed to be of this age.

The lead and zinc lodes of Leadhills and Wanlockhead in Scotland are attributed to the Caledonian folding as also the ores of copper, nickel, titanium and chromium of northern Norway connected with gabbros in the Cambrian-Silurian complex.

The Hercynian movement came between the Carboniferous and the Trias and resulted in great mountain chains extending east and west across Europe. In England, this is known as the Pennine-Armorican movement; and the formerly copper but now tin, and the lead and zinc lodes of Devon and Cornwall are genetically connected with the west-of-England granites. Although their direct association with any intrusive body is not obvious, the lead and zinc lodes in the Carboniferous limestone of the Pennine range at intervals from Derbyshire to Northumberland are connected with the Pennine folding.

In the continent, the Linares field, once the most prolific lead mines in the world, and the equally famous Rio-Tinto and Tharsis mines in Spain, the classical lead and zinc veins of Clausthal in the Hartz mountain, the Erzegebirge field, the tin fields at Zinnwald in Germany are all connected with granites and with the Hercynian movement. The Altaid mineral deposits of the Urals and the poly-metallic lodes of Balkash in Eastern Russia, and along the Russo-Afghan border all belong to this period.

With the ridging up of the Alps, southern Europe became the scene of great activity in connection with igneous outburst. The lead and zinc deposits of Raibl in Italy, Bleiberg in Austria and Mesieza in Yugoslavia are connected with the great Alpine intrusions of granitic rocks. The Eocene intrusions of peridotite, gabbro, etc., gave rise to the magmatic chromite deposits in Greece and Asia Minor. The metal mercury is especially associated with this movement; the Spanish Almaden mines and the Idria mine in Italy are of this period.

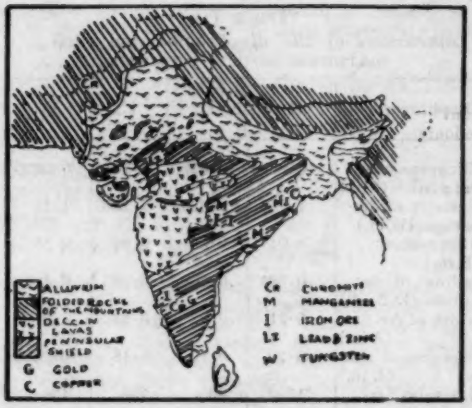
In the United States of America, taking the Cordilleran region alone, which is one of the great mineral store-houses of the world, we find that here three distinct metallogenetic epochs are recognized, *viz.*, pre-Cambrian, post-Jurassic and late Cretaceous—Tertiary the last two of which are clearly related to periods of mountain-building. The Sierra Nevada and the Coast Range are post-Jurassic in age and the mineral deposits that occur here are genetically related to the Sierra Nevada and the Coast Range granodiorite batholiths. The metals worked are gold, copper, lead and zinc.

The Rocky mountains were ridged up from late Cretaceous to Tertiary, and the mineral deposits around the Columbia and Colorado plateaux are connected with igneous activity that took place about this time. The metals mined are silver, gold, lead and zinc (not conspicuous), tellurium, antimony and quicksilver.

In Asia, pre-Cambrian deposits are represented by gold-bearing veins in the great shield extending on both sides of Lake Baikal and in Korea, and in the Indian Peninsular Shield. Deposits of Hercynian or late Palæozoic age are found in many ranges in Central Asia, such as the Urals, the Altai and the Trans-Baikalian mountains. Gold, lead, silver and other metals are found here in well-defined veins. To the same age are referred the tin and wolfram deposits of Malaya, Burma, Siam and China.

In southern China at least five orogenic periods have been recognised, *viz.*, Caledonian, Hercynian, Anyuanian (late Triassic), Yenshanian (phase A in late Jurassic, phase B between Cretaceous and Eocene) and Nanlingian (middle Tertiary). Of the three metallogenetic periods in China, namely, (1) Pre-Cambrian, (2) Hercynian and (3) Tertiary, the first is connected with deposits of gold, tungsten and molybdenum the next with tin, zinc and antimony, and the third with mercury: all genetically related to granitic intrusions.

In India, the two generally accepted orogenic movements are the pre-Cambrian, which ridged up the Aravalli mountains and the Himalayan in Tertiary time. Recently, however, Prof. Pichamuthu has been able to decipher two more orogenic periods in the Dharwars of South India.



From a study of the metal deposits of India and Burma five metallogenetic epochs can be pretty well recognized, namely, pre-Cambrian, Malani (pre-Vindhyan), Caledonian, Hercynian and Cretaceous.

As producers of economic deposits, however, the pre-Cambrian is the most important epoch in India, while in Burma, both the Caledonian and the Hercynian are of great importance.

Covering nearly one-third of India's sixteen lacs square miles, the Peninsular Shield contains nearly all her metal deposits including the most important ones, *viz.*, gold, copper, chromite, iron and manganese (the last two being sedimentary).

In the Dharwars of South India occur the gold-bearing quartz-veins related to the granitic constituents of the Champanir gneiss. Belonging to the iron-ore series are the Singhbhum copper deposits related to a Soda granite. The Khetri copper deposit is in Aravalli slates.

The Mysore, Madras, Keonjhar and Singbhum chromite deposits are genetically connected with the ultra-basic rocks in which they occur.

It is, however, too early to say to which of the two Dharwarian orogenic movements these several metal deposits owe their origin.

The wolfram deposit of Degana in Jodhpur State and the Jawar lead and zinc deposit in Udaipur State are intimately connected with the Jalore and Siwana granites of Malani age.

Related to the Tawnpeng granite the Bawdwin lead, zinc and silver deposits have been assigned a Cambrian age (not with great certainty), and possibly owe their origin to some movement corresponding to the Caledonian in Europe. The Mawson lead deposits also belong to this period.

To the Hercynian we owe the tin and wolfram deposits of Burma, the zinc deposit of Riasi in Kashmir, and the orpiment deposit of Chitral.

Closely connected with the late Cretaceous movement, well recognized in Burma, are the chromite deposits of the Arakan range and of Pishin-Zhob in Baluchistan.

The following table gives an idea of the repetition of metal deposition through geological time.

Period	Europe	North America	Asia	India and Burma
Pre-Cambrian ..	Iron, Copper	Gold, copper, nickel, silver	Gold	Gold, copper, chromium
Malani ..	..	..	..	Tungsten, lead, zinc
Caledonian ..	Lead, zinc, copper, nickel, titanium, chromium	Gold	..	Lead, zinc, silver, nickel
Hercynian ..	Copper, tin, lead. zinc	..	Gold, lead, silver, zinc, antimony	Zinc, tin, tungsten, arsenic
Cretaceous ..	..	..	Gold, copper, lead, zinc, silver	Chromium
Tertiary ..	Lead, zinc, chromium mercury	Gold, silver, copper lead, zinc, arsenic, antimony, mercury	Gold, copper, antimony, mercury	..

OCCASIONAL DISTANT WEATHER INFORMATION AND FORECASTING

S. L. MALURKAR

(*Poona* 5)

A WEATHER forecaster depends entirely on the amount of meteorological observation that he has at the time of issuing forecasts. It often happens that at certain places, the amount of weather information is limited due to communication difficulties. During the period of war, much of the needed weather information is absent. The forecaster has to strain to deduce more results with the little information he has. The method of deducing the results here, follow from the book *Forecasting Weather In and Near India*.[1]

If a broadcast or news item gives an account of extensive damage due to weather in the tropics, away from the equator, it is most likely that a cyclonic storm or typhoon would have been responsible for the damage. If, in the equatorial regions, heavy rain is reported in the absence of cyclonic storms, it shows the passage of 'pulses' of maritime air which may later in their travel cross to the north of the equator from the south or *vice versa* and become the respective equatorial maritime airs. If in higher latitudes (20° to 25° N) damage or bad weather is reported in terms of dust or thunderstorms, the passage of an extra-tropical disturbance can be inferred. Even in the Sahara region, some Geographical Expeditions have mentioned of sudden showers and later clearing up, which can only be assigned to passing extra-tropical disturbances.

In news items of the daily papers or radio-broadcasts, mention is generally made of the more destructive typhoons in the China Seas. Sometimes, the item of news may be merely the delaying of the sailing of steamers due to bad weather or the extensive damage to coastal towns or even to seacraft. In all these cases, it is possibly due to the presence of a typhoon in the China Seas. If the report of the typhoon is not too far north of the equator, one can assume that a secondary effect of the typhoon would influence the Indian weather. The idea of excluding typhoons too far north of the equator is to prevent the tropical cyclonic storms and extra-tropical depressions from getting mixed up.

In tropical cyclonic storms, three air masses are involved: (1) Em, the equatorial maritime air which crosses at intervals, under favourable conditions, the equator from the other hemisphere, (2) Tr, a mixed or transitional air containing a mixture of the tropical maritime and tropical continental air in varying proportions and whose ultimate origin should be the north Pacific high and the north Asiatic high, and (3) Tc, the dry continental air, being a mixture of tropical continental air and a small amount of Polar continental air. The first air mass, which has come from the other side of the equator is a bigger determinant of the tropical cyclonic storm than the other two air masses which are available on the same side of the equator as in the tropical cyclonic storm. The presence or existence of these latter two air masses can be assumed as a rule. As Em crosses the equator, not daily, but only at intervals when other conditions are favourable, it can be concluded that the existence of the tropical cyclonic storm, by itself, is an evidence of the favourable conditions for the passage of Em across the equator. The actual conditions have been set out in the book.[2] The Em must have crossed as a 'pulse' from the other side of the equator due to the interposition of a high wedge or ridge across its path and with favourable conditions north of the equator (in case of the northern hemisphere). If the 'pulse' had to cross to the north of the equator due to the interposition of the high ridge, to the west of the ridge a secondary 'pulse' would start in its mainly westward motion to produce the Em of more westerly longitudes. It may cross to the north

of the equator if another high pressure ridge came across its path with favourable conditions in the north. The cycle of successive secondaries continues in the tropical belt round the equator. If the secondary 'pulse' of equatorial maritime air crosses into the Indian area, unsettled conditions would be produced there and if the feed of the other two air masses is possible, a depression or a cyclonic storm forms in the north Indian Ocean. A knowledge of the China Sea typhoon is a fore-warner of the possible unsettled conditions or a depression in the Indian area. As regards the time interval that one has to expect before the 'pulse' crossed into the Indian area from the time the original or primary 'pulse' crossed into the China Seas to give the typhoon there, the general experience of the weather forecaster comes in handy. It is a well-known fact that though a depression is forming in the Bay of Bengal, conditions get unsettled almost simultaneously in the S.E. Arabian Sea. Though the number of observations are few in the South Indian Ocean, it is found that almost at the same time a 'pulse' is crossing into the northern hemisphere, a secondary 'pulse' is almost readily formed and moving in its westerly history. The crossing of the original 'pulse' of Em to the China Seas can almost be "ignored" as though the original 'pulse' travelled only westwards and reached the Indian longitudes. The information of the typhoon is merely used for the knowledge that fresh air is moving south of the equator. To put it in other words, the 'pulses' move with a sort of "group" velocity forming secondaries successively after each crossing to the north. The approximate rate of travel of the fresh air masses south of the equator has been mentioned to be between 300 and 500 miles a day.[3]

If the information is from the equatorial latitudes, where cyclonic storms are rare, *e.g.*, a mention of heavy rain at Singapore or in Java, it would indicate that fresh maritime air is passing over the place. A 'pulse' of fresh maritime air may be moving from the east, south of the equator, which may later cross into the Indian longitudes and produce successively in the Bay of Bengal and the Arabian Sea unsettled conditions and sometimes depressions. Alternatively, the heavy rain in S.E. Asia may be due to the motion of a fresh air mass from the north to the south to feed a southern tropical depression. A forecaster would be able to distinguish whether the heavy rain is due to a 'pulse' moving south of the equator westwards or due to an incursion of fresh air from north of the equator.

Next there may be information about a hurricane or a typhoon in the southwest Pacific Ocean, in the southern hemisphere away from the equator. If the hurricane is too far south, it need not be considered here. However, if a hurricane or a typhoon was crossing over north Australia, the forecaster has to be on the look out. The presence of the typhoon, hurricane or cyclonic storm south of the equator would result in a stimulation of air from the east. The hurricane may move straight west or west-southwest to the Indian longitudes in the South Indian Ocean. If the hurricane recurved to West Australian coast, it may create a secondary north of it (nearer the equator), which may move westwards into the South Indian Ocean and be for all purposes as effective as if the original hurricane moved dead west. The passage of 'pulses' south of the equator to form or feed a depression, later, in the northern hemisphere produces heavy weather in the regions south of the equator,[4] or a tropical depression in the northern hemisphere is associated with unsettled weather in the southern hemisphere in the neighbourhood of the equator a few days previously. Similarly the passage of a tropical depression south of the equator, when not too far south, in South Indian Ocean would draw fresh 'pulses' from the northern hemisphere and give rise to unsettled weather in the Bay of Bengal and the Arabian Sea successively. Hence with a knowledge of a hurricane in North Australia, the forecaster in India would be on the look out for unsettled conditions in his own area after a definite interval of time. Due to successive incursions of air from one side of the equator to the other and interplays of the other air masses, the unsettled conditions in the North Indian Ocean (produced by the southern tropical depression or cyclonic storm) may give rise to an independent circulation, i.e., a secondary of the southern depression may be formed in the northern hemisphere.[5] The secondary of a tropical depression formed on the other side of the equator, has the tendency to weaken the primary tropical depression and in turn weaken itself.[5] The co-existence of the two tropical cyclonic storms on two sides of the equator is not possible (i.e., with all the three air masses). Hence if the southern depression shows no sign of weakening, it can be assumed that the northern secondary would not be well formed. When the southern depression has moved to a southern latitude too far—when there is a tendency to recurve into an extra-tropical depression with only two air masses—or when the southern depression has moved too far west of the northern secondary, the depression in the Indian area has a chance of developing fully. Otherwise, the northern low pressure areas act as 'pulses' feeding into the southern depression. Due to extensive land masses in the northern hemisphere, the northern 'pulses' or low pressure areas are not as clear as their southern counterparts. However, due to the passage of an extra-tropical depression in more northerly latitudes, the northern secondary, which is ill-developed, may recurve or move in an easterly direction as a secondary of the western disturbance[6] or extra-tropical depression, and may cause bad weather. Even then, the effect of the recurved northern depression remains small unless and until the southern depression has moved too far west or too far south of the northern depression;[7] the forecaster would give less weather than the observations from the north of the equator would by themselves warrant. These ideas have been used for the last few years with success. On December 2nd 1946, Melbourne broadcast the news about the loss of a ship during the previous week-end (probably 30th November) in Torres Straits (between New Guinea and Australia), due to

a hurricane which was the severest since 1922. The hurricane, itself, travelled almost west (or perhaps induced an equally severe secondary) into the South Indian Ocean and continued strong. The series of low pressure areas induced in the Bay of Bengal remained ill-defined for more than a week, until a depression that moved north-east formed. But the resulting weather during the week was responsible for dislocation of normal transport in Madras Presidency.

It is necessary to stress the fact that for tropical weather, i.e., the cyclonic storms and the S.W. monsoon, the weather to the east of India has to be known. Though the main high pressure area which gives rise to the 'pulses' is the South American high pressure area, the travel is from east to west in the narrow corridor of pressure between the high pressure areas in the Pacific Ocean.

But for the weather in winter in India, one has to follow the extra-tropical depressions. The meteorological observations that one can get even during peace-time from Egypt to the frontiers of India are very limited due to deserts and uninhabited tracts or meteorologically unrepresented countries. The wide areas happen to be the regions where the secondaries of western disturbances or extra-tropical depressions form. Many of these secondaries have to be inferred after they have produced weather. Hence there is a need to know about them much earlier. The damage that occurs due to these western disturbances do not have much news value. It is only occasionally that the damage is great enough to be advertised. If such an event occurs either in Egypt or Palestine, it can be assumed that an active extra-tropical disturbance is passing over the countries. These active extra-tropical disturbances would develop secondaries.[7] One or the other of the secondaries would affect India. In the absence of a depression south of the equator moving westwards, the forecaster can anticipate the formation of an active secondary of the extra-tropical disturbance and be forewarned. During the last days of March 1944, a very active extra-tropical depression moved across Egypt and Palestine and caused considerable dislocation. The disturbance which had been detected by the interference in the reception from Ankara[8] could be better evaluated after the receipt of the above information and the forecasts on 1st April, and subsequently could be made more informative. The weather in upper India in the first few days of April 1944 resembled a good rainy day during the monsoons. A southern depression appeared (south of the equator) about the 4th April in the longitudes 90° to 100° moving westwards. The weather over upper India rapidly cleared up after 6th April.

If attempts are made to catch the weather summaries of various meteorological offices, and the weather information that form the "news items", a better appreciation of weather over a larger area can be got, and it would enhance the value of one's forecasts.

The above speculations also lead to the conclusion that a criterion *can be given* strictly separating tropical weather from non-tropical weather. The tropical weather has essentially an eastern origin and travels westwards, while the non-tropical weather has a western origin and moves eastwards. Due to interaction of the various weather situations, *e.g.*, the recurvature of a tropical cyclonic storm under the influence of an extra-tropical disturbance or the greater activity of a western disturbance due to an infeed of N.E. Trades, in any season, one has to watch for signs of weather from both the east and the west.

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1 Malurkar, *Forecasting Weather In and Near India*, 1945 (Private circulation). 2. —, *Ibid.*, p. 34 and p. 87, 3. —, *Ibid.*, p. 119. 4. —, *Ibid.*, p. 24 and p. 64. 5. —, *Ibid.*, p. 96, *et seq.* 6. —, *Curr. Sci.*, 1941, **16**, 14. 7. —, *Ibid.*, p. 139. 8. —, *Proc. Nat. Acad. Sc.*, (Allahabad), 1944, **A, 14**, 131.

OBITUARY

PROFESSOR GEORGE MATTHAI, M.A., Sc.D. (Cantab.), F.L.S., F.R.S.E., F.N.I.

THE sudden death at Cambridge of the distinguished zoologist, DR. GEORGE MATTHAI, Emeritus Professor of the Punjab University, has deprived the science of Zoology of one of its most ardent votaries and his friends and pupils of a lovable personality and inspiring teacher. At a time when this country needs all its ablest men to help in the great task of developing its scientific resources the loss of a scientist of his calibre leaves a gap that will be difficult to fill.

George Matthai belonged to a cultured and gifted family of Syrian Christians from Travancore, his father having later migrated to Calicut. Born at Palghat in Malabar about 59 years ago, he received his early education at the Zamorin's College, Calicut, and later at the Christian College, Madras. Here he graduated, and for about a year served as a lecturer in zoology before he left India for a career of research at Cambridge.

It was at Cambridge, where so many students from distant parts of India are thrown together, that the writer first met George Matthai. We joined Emmanuel College in the October term of 1911 and our association there of about seven years matured into an abiding friendship. Matthai, with already a Master's degree from Madras, and some experience as a College lecturer, was admitted at once as a research student (under Stanley Gardiner), and we juniors, who had yet to go through the mill of the Tripos, at first looked up to him with some degree of deference. Thirty-six years ago it was unusual, not to say rare, to find an Indian student at Cambridge pursuing scientific research, and Matthai was justly aware of a certain glamour that surrounded him. As the years went by we saw him build up an international reputation by his original work, and he inspired us with his example.

Within a couple of years he had made a name for his researches on the morphology and classification of the Madreporarian Corals. The special merit of this work was that it took into account the structure of the soft parts of the body, which were expected to provide a more rational index to affinities than the calcareous skeleton alone. Obviously, the most natural classification would be one erected on the combined basis of the soft parts and the calcareous skeleton. And it would be particularly interesting if a correlation could be established between the structure of the soft parts and the hard, for in that case the perplexing variety of skeletal forms which are grouped in an artificial taxonomy, including all the fossil types of which the soft parts can never be found, could be assigned to their natural places in the evolution of the group.

Matthai's comprehensive and painstaking work thus had very substantial value. Already in 1914 his first monograph on the Astræidæ appeared in the *Transactions of the Linnean Society of London*. The completion of the second was delayed until after the War of 1914-18; meanwhile he had to leave Cambridge to take up an appointment at Lahore. The second monograph was completed during a period of leave in England, and was published as a *British Museum Catalogue* in 1928. Meanwhile he had revised the Madreporarian Corals in the collections of the Indian Museum in Calcutta (*Rec. Ind. Mus.*, 1924); and in 1926 had appeared his important work on the histology and modes of budding in corals as determining the farms of the colonies. This was published in the *Philosophical Transactions of the Royal Society*. In 1940 he discussed the theoretical bearings of his work, summarising his conclusions regarding evolutionary tendencies in the Astræidæ. Latterly he was engaged in the study of the colonial Fungidæ.

Matthai travelled widely in search of his material, undertaking several cruises, *e.g.*, along the coast of Florida, in the West Indies, and in the Indian Ocean. For his taxonomic work he examined all existing type collections in Europe and America. His studies on corals thus formed the main theme of his work, and they are regarded by competent authorities as a monumental contribution to our knowledge of the Madreporaria.

While he was still a young student at Cambridge the importance of the researches in which he was engaged was recognised by the award to him of the Mackinnon Studentship of the Royal Society, and of generous research grants from Emmanuel College and other sources.

In 1918 he was appointed professor of zoology at the Government College, Lahore. There he soon made his mark as a teacher. As Dean of University Studies he did much to stimulate zoological research in the Punjab. At semi-popular lectures he impressed one by his mastery of style as much as by his discrimination in presenting facts. The result was a delightful clarity of exposition.

Two years later we were again brought together for a year at Lahore, where we saw a good deal of each other during the academic session of 1920-21. In January 1923 he came to Lucknow to preside over the section of Zoology at the Tenth Indian Science Congress.

While on leave in England in 1925, he married Mary Chandy, second daughter of the late Mr. C. Chandy of the Mysore Civil Service and later a Vice-Chancellor of the University of Mysore. They had one son, Ariel, an only child, who survives him.

In 1929 Matthai's published work, now voluminous and impressive, was rewarded by the University of Cambridge with the conferment of the degree of Sc.D., the highest degree which that University can bestow upon a man of Science. He was one of the Foundation Fellows of the National Institute of Sciences of India, a Fellow of the National Academy of Sciences, of the Linnean Society of London and of the Royal Society of Edinburgh. In January 1931 we met again at the Nagpur Session of the Indian Science Congress—an occasion marred by the news we there received of the death of Mrs. Matthai.

In 1938, when the Silver Jubilee of the Indian Science Congress was celebrated at Calcutta in a joint session with the British Association, Matthai again presided over the section of Zoology. In both his presidential addresses to the Congress the main theme was research in oceanography and the marine faunas, particularly those of the Indian Ocean, a subject in which he was always at home. He retired from the chair at Lahore in 1943, on reaching the age of 55, but continued his research activity. For some time in 1946 he acted as Director of the Zoological Research Laboratory at the University of Madras.

In his scientific work Matthai was essentially a man of facts, rather than theories: inquisitive by nature, orderly and correct to the limit of punctiliousness. His strict attitude to the observed facts of Science, and his deeply religious temperament were two aspects of the same personality. While always mindful of the rights of others he knew how to assert his own, and to hold his head high. He never grudged any help that he could render to others with his knowledge or advice.

Towards the end of June last year, when I happened to spend a week again at Cambridge, it was a pleasant surprise to know that he was also living at the College. Chatting away into the small hours of the morning we lived the old Cambridge days once again in the familiar scenes of our 'undergrad' years: several of our contemporaries are now dons at Emmanuel and other Colleges. We said Goodbye on the 29th of June 1946—it was to be for the last time. On the 25th June 1947, weighed down by prolonged anxieties, he suddenly took leave of this world, to the grief of all who knew him. He will be missed by his many friends for his frank and lively expression as he greeted them with his vigorous handshake.

(For some of the personal facts relating to the early life of Dr. George Matthai I am indebted to his nephew, Dr. K. Jacob, of the Geological Survey of India, and to Dr. N. K. Panikkar of Madras.)

B. SAHNI.

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PHOTOCHEMICAL AFTER-EFFECT IN THE DECOMPOSITION OF HYDROGEN PEROXIDE BY POTASSIUM FERROCYANIDE

It has been shown that the photochemical after-effect in the decomposition of hydrogen peroxide by pre-illuminated ferrocyanide can be reproduced in the dark by adding small quantities of the aquo-salt (II), sodium aquopentacyanofertile, to the unilluminated H_2O_2-$K_4Fe(CN)_6$ mixture.[1] Sodium aquopentacyanoferrate, the violet aquo-salt (III), can also be used with similar results. These observations support the view that potassium aquopentacyanoferrite produced photochemically and reversibly in the illuminated solutions of potassium ferrocyanide brings about the photochemical after-effect.

The above view has been tested in another way. It is known[2] that sodium aquopentacyanoferrite reacts with sodium nitrite and nitrosobenzene forming quaternary nitroprusside and a purple-coloured substitution compound respectively :—

$$Fe(CN)_5H_2O''' + NO_2' \rightarrow Fe(CN)_5NO_2'''' + H_2O \quad (1)$$

$$Fe(CN)_5H_2O''' + C_6H_5NO \rightarrow Fe(CN)_5C_6H_5NO''' + H_2O \quad (2)$$

It folows that if the aquo-salt formed from ferrocyanide by insolation causes the photochemical after-effect, the addition of nitrite and nitrosobenzene should considerably reduce or "quench" the after-effect, as the decomposition of hydrogen peroxide by nitrosoprusside formed in (1) is very slow in the dark,[3] and the purple substitution compound formed in (2) is also not very reactive towards hydrogen peroxide.

Potassium ferrocyanide solution (M/64), 10 c.c., was pre-illuminated by direct sunlight for one minute, and added to hydrogen peroxide immediately after darkening, or it was first mixed with aqueous nitrosobenzene or nitrite just after illumination, and then added to hydrogen peroxide in the dark. The concentrations of hydrogen peroxide and ferrocyanide in 50 c.c. of the reaction mixture were N/6 and M/320 respectively. A saturated solution (5 c.c.) of freshly prepared nitrosobenzene in conductivity water was used. Temperature of the reaction was 40° C. The velocity constant has been calculated according to the Unimolecular formula, $K = 1/t \log a/a - x$ where t represents time in minutes, a the initial concentration of H_2O_2 in terms of c.c. of permanganate, and x the change in time t.

Table 1

Without nitrite or nitrosobenzene

t	$a - x$	$K \cdot 10^4$
0	16·10	..
12·5	13·80	54
26	11·40	58
37	9·80	58
57	7·50	58

TABLE 2

With 5 c.c. aqueous nitrosobenzene

t	$a - x$	K·10⁴
0	16·25	..
15	14·60	31
34	12·80	31
65	10·00	32
100	8·00	31

TABLE 3

With 0·0020 gm. sodium nitrite

t	$a - x$	K·10⁴
0	13·60	..
15	12·95	14
34	12·40	12
68	12·00	8
120	11·30	7

The slightly higher value of K.10⁴ (54-58) in Table 1 (*cf. Curr. Sci.*, April 1947, p. 118) is probably due to a small change in the intensity of sunlight.

It is seen from Table 2 that nitrosobenzene reduces the photochemical after-effect to a considerable extent, while the nitrite is still more effective in suppressing the after-effect.

A mixture of potassium ferrocyanide and potassium cyanide pre-illuminated and then added to hydrogen peroxide in the dark does not show any after-effect. This is to be expected if the photo-formation of the aquo-salt from ferrocyanide is responsible for the after-reaction. In the presence of added cyanide, the equilibrium

$$K_4Fe(CN)_6 + H_2O \underset{\text{Dark}}{\overset{\text{Light}}{\rightleftharpoons}} K_3Fe\,CN)_5H_2O + KCN$$

is shifted to the left, resulting in practically complete suppression of the concentration of the aquo-salt, so that none exists in such an illuminated solution to produce the after-effect.

It has been further established that the after-effect reproduced in the dark by the addition of minute quantities of the aquo-salt (II) to H_2O_2-$K_4Fe(CN)_6$ mixture is also completely suppressed by CN' and NO_2', while the diminution brought about by nitrosobenzene is of the same order as already reported in the case of the photochemical after-effect. Pre-illuminated ferrocyanide on treatment with suitable quantities of nitrite or cyanide ions does not answer the tests for the aquo-salt (II), and the pure aquo-salt (II) in the presence of these ions is completely converted into nitroprusside and ferrocyanide respectively.

The photochemical after-effect cannot be ascribed either to alkali or to ferricyanide produced in the course of the reaction, as the experiments with unilluminated ferrocyanide and ferricyanide and alkali failed to show the rapid decomposition characteristic of the illuminated ferrocyanide, which is known to contain minute quantities of the aquo-salt (II). In this connection attention is drawn to an earlier paper by Lal and Singhal[4] in which the decomposition of hydrogen peroxide by ferricyanide has been discussed.

It has already been reported that aqueous solutions of aquopentacyanoferrite exhibit a slow spontaneous decomposition in the dark at room temperature in the presence of air, and the aquo-salt is completely decomposed into ferric hydroxide, ferri- and ferrocyanide. These changes are greatly accelerated by light and heat, and this appears to be the cause of the photosensitivity of the aquopentacyanoferrite ion.[5] These observations are in general agreement with those of Iimori.[6] It is significant to note that the sodium aquo-salt after being heated to about 90° C. for a few minutes or exposed to direct sunlight for about an hour does not give the characteristic colour reactions with p-nitrosodimethylaniline or nitrosobenzene.[7] An aqueous solution of the sodium aquo-salt kept in the dark for a few days shows the same behaviour.

Recently, Williams[8] has studied the causes of discolouration of ferro- and ferri-cyanide crystals and has come to the conclusion that the decomposition of the aquo-salt (II) takes place spontaneously in the dark in the presence of air with the formation of ferric hydroxide and ferricyanide. In view of these results, the suggestion of Baudisch[9] that prolonged insolation of ferrocyanide in the presence of air results in the formation of an oxygen-richer product which gives a blue colouration with tincture of guaiacum appears to be untenable. Rather, one should expect this guaiacum colour reaction as indicative of the decomposition of the photochemically produced aquo-salt (II) into ferricyanide, which is known to produce a blue colouration with tincture of guaiacum.

Attention may also be drawn to the author's observation that contrary to the findings of Baudisch (*loc. cit.*) there is reason to believe that free aquo-salt (II) exists in illuminated ferrocyanide solutions in the presence of air in the initial stage of insolation. Further Baudisch has remarked that in the presence of air and light the yellow aquo-salt (II) formed from ferrocyanide is oxidised momentarily to deep violet-coloured aquo-salt (III), which then reacts with the aquo-salt (II) to form higher complexes of pale yellow colour. The ready reducibility of the violet aquo-salt (III) to yellow aquo-salt (II) in the presence of excess ferrocyanide as noted by Williams and others and the existence of free aquo-salt in presence of ferrocyanide, however, go against the suggestion of complex formation between the two aquo-salts in aqueous ferrocyanide solutions. Experiments already in progress are expected to elucidate the mechanisms involved in the action of light on ferrocyanide.

The details of the investigation will be published in due course.

Chemical Laboratory, Archæological Survey of India, Dehra Dun, *July* 1, 1947. B. B. LAL.

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A RELATION BETWEEN REFRACTIVE INDEX AND VISCOSITY

LAGEMANN[1] combined Mott Souder's[2] viscosity relationship with the Lorentz-Lorenz equation and came to the conclusion that for liquids in general, a rough rule is that Mott Souder's viscosity-constitutional constant I is about twelve times the molecular refraction. It has been found that this relationship holds only for aliphatic liquids. The ratio for some simple aromatic liquids is given in the following table :

Ratios of I and M for some aromatic liquids

Compound	I	M	I/M
Benzene ..	249·9	25·96	9·6
Toluene ..	296·5	30·80	9·6
Ethylbenzene ..	344·1	35·37	9·7
o-Xylene ..	346·1	35·48	9·7
m-Xylene ..	344·1	35·64	9·6
p-Xylene ..	346·1	35·70	9·7
Aniline ..	280·6	30·29	9·3
Methylaniline ..	328·2	35·24	9·3
Benzylamine ..	328·2	34·15	9·6
Ethylaniline ..	383·8	40·05	9·6
Dimethylaniline ..	383·8	40·41	9·5
o-Toluidine ..	330·0	35·01	9·4
Nitrobenzene ..	310·2	32·37	9·5
o-Nitrotoluene ..	353·8	37·05	9·5
Chlorobenzene ..	290·2	30·90	9·4
Bromobenzene ..	309·2	33·76	9·2

From the above table the conclusion may be drawn that for simple aromatic liquids Mott Souder's[1] I is roughly 9·5 times the molecular refraction.

The values of I have been taken from Mott Souder's paper and those of molecular refraction from Landolt-Bornstein Tabellen.

My thanks are due to Sir J. C. Ghosh for kind advice.

Dept. of General Chemistry, Indian Institute of Science, Bangalore, *July* 4, 1947. B. K. BANERJI.

1. *J. Amer. Chem. Soc.*, 1945, **67**, 498. 2. —, *Ibid.*, 1938, **60**, 154.

TREATMENT OF ALKALINE WATER TO RENDER IT SUITABLE FOR REELING SILK

IN the course of our studies on the quality of raw silk produced in certain silk filatures in South India, some interesting observations have been made. One of the points of considerable scientific and practical importance relates to the influence of water used for cooking the cocoons and reeling the filaments on the quality of silk.

The bore-well water used in one of the silk filatures was found to affect the processing of cocoons and the quality of the silk. Although the cocoons were found to cook much quicker than in other waters, more sericin (silk gum) was dissolved in that water thereby necessitating more frequent change of water in the cooking and reeling basins. The silk fibres, as they were reeled over and hanks were made, were found to retain more moisture, stick together and take longer periods to dry. After drying, hard gum spots and variations in colour, from light greenish yellow to deep greenish yellow, were noticed. These conditions adversely affected the normal properties of the silk, particularly its lustre, feel, evenness, neatness, cleanliness and its winding property. When, instead of the bore-well water, water from other sources, such as from the tank (rain-fed) in the neighbourhood or from the river about two miles away from the filature, was employed the silk reeled was free from the above-mentioned defects.

The unusual features of the bore-well water were its bicarbonate alkalinity and temporary hardness, the permanent hardness being relatively inconsiderable. 100 c.c. of the water required 33 to 40 c.c. of N/50 acid for neutralisation, and the temporary hardness was 18 to 28 parts per 100,000, as observed during different seasons over a period of four years. In view of this observation, further trials were carried out by treating the bore-well water with calculated amounts of mineral acids (such as sulphuric and hydrochloric acids) and organic acids (such as acetic, oxalic and tartaric acids) in order to neutralise the alkalinity of the water or reduce it to that of the river water which was found satisfactory for silk reeling. The results of these studies confirmed the above observations and indicated that a simple and cheap method of treating the bore-well water was just to neutralise its alkalinity or reduce it to a minimum by adding sulphuric acid (commercial grade) and vigorously stirring the water by means of an efficient blower so that no free acid was left in the water. Thus it was observed that the quality of the silk reeled in the bore-well water after treatment with sulphuric acid (0·75 c.c. of concentrated acid per gallon of the water for bringing down the alkalinity from 37 to 9 in terms of N/50 acid for 100 c.c. of the water) was comparable to that reeled in the river water (100 c.c. of this water required 8·9 c.c. of N/50 acid for neutralisation).

The practical application of the above findings under the working conditions of a filature presents some fresh problems. If the water in

the cooking and reeling basins is treated, the beneficial effect of neutralisation lasts for only a short time. Unknown quantities of fresh alkaline salts are brought in through the 'creeping' of water with the steam used for the heating. The water carried with the steam contains alkali carbonate formed through the decomposition of the alkali bicarbonate by heat. This is now sought to be remedied by the introduction of suitable traps and other devices which will introduce only dry steam. Steam jacketing of the basins would also be an elegant way of dealing with this difficulty.

If the discolouration of the silk is not material (depending upon its use) and gum spots alone are to be minimised, this can be done by drawing the silk thread through a groove containing some vaseline or other grease prior to winding round the hank. This has already been tried successfully in one filature.

A detailed account of the work including the quantitative data relating to the quality of the reeled silk will be published elsewhere.

Dept. of Biochemistry, S. C. PILLAI.
Indian Institute of Science, V. SUBRAHMANYAN.
Bangalore,
August 2, 1947.

THE CYSTINE AND METHIONINE CONTENTS OF COMMON INDIAN FOODSTUFFS

No detailed work on the analysis of foods for their contents of methionine and cystine in common Indian foods has yet been done. While the cystine content of some food proteins has been determined, very few have been analysed for methionine. The reported cystine values are on certain fractions of isolated proteins. The whole proteins of foods have not been taken into account during the analysis except for certain values reported by Chitre and Keni.[1] This is because no satisfactory methods existed, till recently, for analysing the whole proteins of foods for their cystine and methionine contents. Recently, however, reliable methods for their analyses have been developed. Apart from the microbiological method, Evans[2] has developed a wet digestion method for analysis of these constituents. The method consists in analysing the food-stuff for (i) Total sulfur, (ii) Inorganic sulfur and (iii) Sulfur oxidised to sulfate by nitric acid.

The above method was used in the following determinations. From the cystine and methionine sulfur values the actual amino-acid contents were calculated by using the appropriate conversion factors (3·747 for cystine and 4·651 for methionine). The combined nitric and perchloric ecid digestion method[3] was used for the determination of total sulfur.

The final data about the cystine and methionine contents of the foods are tabulated below.

It will be seen that among the cereals, rice contains a high percentage of methionine. The cystine percentage is about the same in all cereals. Except for Dolichos and horsegram, the total percentage of sulfur amino-acids in all other pulses is about the same. Green-gram and the cowpea contain a large proportion of methionine. Among oilseeds, soya bean and sesamum contain a large amount of total sulfur and a fairly large proportion of methionine also. About three-fourths of the total sulfur in groundnut is, however, in the form of cystine only.

TABLE I
Cystine and Methionine Content of Some Indian Foodstuffs
(per cent. of air dry samples)

Foodstuff	Protein	Cystine	Methionine
I. *Cereals*			
*(i) Rice (*Oryza sativa*)	6·9	0·27	0·31
(ii) Ragi (*Eleucine coracana*)	7·1	0·23	0·23
(iii) Cholam (*Sorghum vulgare*)	10·2	0·24	0·21
(iv) Wheat (*Triticum vulgare*)	11·7	0·28	0·27
II. †*Pulses*			
(i) Bengal gram (*Cicer arietinum*)	17·3	0·53	0·20
(ii) Green gram (*Phaseolus ra[illegible]*)	22·3	0·49	0·42
(iii) Black gram (*Phaseolus mung*)	23·1	0·51	0·32
(iv) Tugar Dhal (*Cajanus indicus*)	22·2	0·59	0·32
(v) Dolichos (*Dolichos lablab*)	23·8	0·32	0·31
(vi) Horsegram (*Dolichos biflorus*)	21·3	0·42	0·14
(vii) Cow pea (*Vigna catiang*)	24·1	0·45	0·43
III. *Oilseed cakes*			
(i) Groundnut (*Arachis hypogea*)	51·2	0·76	0·26
(ii) Soya bean (*Glycine hispida*)	50·8	1·01	0·58
(iii) Sesamum (*Sesamum indicum*)	33·1	1·12	0·59
(iv) Cotton seed (*Gossypium barbadens*)	24·2	0·89	0·68
(v) Cocoanut (*Cocos nucifera*)	20·3	0·80	0·29

* Polished rice was used.

† The pulses were powdered along with the skin.

If the amino-acid contents are expressed as per cent. of the protein content, the cereals are the best sources of methionine while the pulses and the oilseed cakes constitute the richest sources of cystine.

Our thanks are due to Prof. V. Subrahmanyan for his keen interest in the work.

Dept. of Biochemistry, H. S. R. DESIKACHAR.
Indian Inst. of Science, S. S. DE.
Bangalore,
August 12, 1947.

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INFLUENCE OF VARIETY, MANURING AND GERMINATION ON VITAMIN B_1 CONTENT OF GROUNDNUT-*ARACHIS HYPOGEA*

AMONG plant materials groundnut is a very rich source of vitamin B_1. The utilisation of groundnut as a source of vitamin B_1 necessitated the study of this important oil-seed from various angles.

Among 40 varieties of groundnut analysed, wide differences were noted in their vitamin B_1 content (the values varying from 5 to 20 per gram of defatted flour). These differences are attributable mainly to varietal differences since all other conditions under which they were grown are identical.

In groundnut about 48 per cent. of the total vitamin B_1 is present in bound form. The bound vitamin can be released by treatment with papain, but taka-diastase has no effect. Sodium chloride (10 per cent.) extracts completely the bound form of the vitamin. It can also be precipitated with trichloracetic acid. These results indicate that the combined vitamin exists bound to protein, and not as co-carboxylase.

It was found that both the bound and the free vitamin in groundnut are completely available, as judged by rat-growth experiments.

There was a gradual decrease in the total vitamin B_1 as the germination advanced. But the bound form of vitamin B_1 is rendered free during germination. This is attributable to the action of porteolytic enzymes formed during germination on the protein-carrier of the vitamin.

The influence of organic and artificial fertilizers on vitamin B_1 content of groundnut was studied in plot experiments at the Mysore Agricultural Farm, Hebbal. The results showed no significant differences in the vitamin B_1 content of groundnuts under different treatments.

Full details of these investigations will be published elsewhere.

Our thanks are due to Professor V. Subrahmanyan for his keen interest in the above work and also to Mr. M. J. Narasimhan, Director of Agriculture (Retd.), Mysore, and to Dr. L. S. Doraswamy, Economic Botanist, and his assistants for supplying the material used in the above investigations.

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Bangalore,
August 27, 1947.

RATE OF REDUCTION OF SULPHATE BY *VIBRIO DESULPHURICANS*, KONÆ

THE formation of the black ferrous sulphide associated with certain types of low-lying and boggy soils in river estuaries, coastal areas and sedimentary deposits of stagnant lakes, has generally been attributed to bacterial action; these bacteria are referred to by previous workers as *Vibrio desulphuricans*.[1] A closely allied type of organism was isolated from the black clay at a depth of about 8-10 feet on the eastern sea coast of India, where, surprisingly, a fairly rich (35 per cent.) deposit of elemental sulphur has been found to occur.[2]

The morphological and biochemical characteristics of this organism, have been described earlier.[3,4] The organism differs from the spirullum of Czurda[5] in that (1) it can reduce sulphate even in absence of carbon dioxide and (2) it is capable of utilising ethyl alcohol and sucrose as the sources of carbon; in other respects they agree. The present communication deals with a study of the rate of reduction of sulphite by *Vibrio desulphuricans*, Konæ.

The nutrient medium was composed of sodium chloride (6 per cent.), recrystallised sodium sulphate (1·0 per cent.), dipotassium hydrogen phosphate (0·2 per cent.), ammonium lactate (0·4 per cent.) and ferric chloride (0·2 per cent). The salts were dissolved in distilled water, the pH adjusted to 7·4 and the volume made up to 100 ml. and sterilised.

Aliquots (10 ml.) of this medium were distributed into sterile bacteriological tubes and the tubes again sterilised at 10 lbs. for 30 minutes. The tubes were then inoculated, each with 1 ml. of a suspension of carefully washed bacterial cells dispersed on 6 per cent. saline and incubated at 30° C.

For estimating the initial concentration of the sulphate, a couple of tubes, immediately after inoculation, were heated in a boiling water-bath to inactivate the bacteria. The sulphate was estimated volumetrically by the benzidine sulphate method.[6] The filtered culture medium (2 c.c.) was acidified with HCl in a centrifuge tube, mixed with a solution of benzidine hydrochloride. The tubes were then cooled in a freezing mixture for 30 minutes and 2 ml. of 95 per cent. alcohol were then added. This facilitated the sedimentation of the thin platelets of benzidine sulphate on centrifugation. The precipitate was washed (four times) with ice-cold 50 per cent. alcohol and transferred to a 25 ml. conical flask and titrated against 0·02 N sodium hydroxide from a microburette. The results are given in Table I and are graphically represented in Fig. 1.

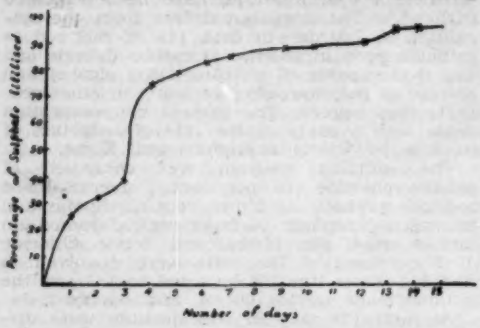
TABLE I

Rate of Reduction of Sulphate by Vibrio desulphuricans *Konæ*

No. of days	SO_4'' present (mgm./2 c.c.)	SO_4'' utilised (per cent)
0	5·91	4·40
1	4·40	25·50
2	3·95	33·10
3	3·27	39·10
4	1·47	75·30
5	1·24	79·40
6	0·99	83·30
7	0·84	85·90
9	0·68	88·50
10	0·65	89·00
12	0·53	91·00
13	0·23	96·30
14	0·23	96·30

The data (Fig. 1) reveal many interesting facts. The rate of reduction of sulphate does

not remain steady; it appears to get suddenly accelerated after 72 hours, maintaining this high rate steady for the next 24 hours. It is during



this period of 24 hours that more than a third of the sulphate is reduced. This period probably corresponds with the period of the growth phase of bacteria. This coincidence is suggestive of the fact that bacteria utilise the oxygen of the sulphate for their metabolic function. The striking fall in the rate of reduction after 96 hours is possibly due to a diminution in concentration of the lactate and the sulphate in the reaction mixture. Further work on the relation between the amount of lactate utilised and the sulphate reduced is in progress.

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Bangalore, India,
September 9, 1947.

1. David Ellis, "*Sulphur Bacteria*" *Monograph*, 1932. 2. K. K. Iya and M. Sreenivasaya *Curr. Sci.*, 1944 **13**, (12), 316-17. 3. —, *Ibid.*, 1945, **14** (9), 243-44. 4. —, *Ibid.*, 1945, **14** (10), 267-69. 5. Viktor Czurda, *Arch. Mikrobiol.*, 1940, **11**, 187-204. 6. Raschig, *Z. anal. Chem.*, 1903, **42**, 617, 818.

THE YELLOWING OF JUTE

STUDIES on the mechanism of discolouration of jute were conducted on samples of jute yarn and powder, subjected to acclerated ageing by irradiation in quartz containers, with light from a quartz mercury-vapour lamp, under various atmospheric conditions. The colours produced on the yarn samples were assessed by a photometric method. It was found that air, oxygen, or ozone did not produce any change of colour in the dark. Furthermore, the discolouration due to the light source was as great in the presence of purified nitrogen as in that of oxygen. The reactions which lead to discolouration are not, therefore, oxidative, as suggested by Sarkar and his colleagues,[1] but photochemical.

Samples of irradiated and non-irradiated jute powder were analysed for main components and a number of associated functional groupings. All the main constituents of jute were found to undergo change during irradiation. Thus, there is a small but distinct loss in the cellulosic fraction, which comprises true cellulose and cellulosan; a very marked decrease in the lignin content, as determined by the residue left after treatment with strong mineral acid; and a reduction of the xylon content as determined by the yield of furfuraldehyde. A large increase in the copper number during irradiation in the presence of oxygen indicates that the cellulosic portion of jute undergoes chain cleavage, and the small gain in uronic acid content suggests oxidation at the terminal carbinol group, similar to the effect demonstrated by Lewis and Fronmuller[2] during the irradiation of wood.

Since purified cellulose undergoes a number of well-authenticated changes but does not discolour during irradiation, it seems unlikely that the cellulosic portion of a lignocellulosic fibre contributes to its photochemical discolouration. This is supported by the fact that degradation of the cellulosic portion of jute is more advanced during irradiation in oxygen than in nitrogen, whereas the degree of discolouration is the same in both cases. Moreover, the degradation products of irradiation of cellulose do not seem to be reactive. Discolouration of the lignocellulosic materials must, therefore, be due to either the ligneous or the hemicellulosic portion, or both. The probability that both these fractions contribute to the discolouration has previously been stated.[3] Sarkar[1] has since shown that delignified jute is discoloured by light and heat and concludes that the residual hemicellulosic constituents are responsible for this. During the accelerated ageing of delignified jute it is difficult to visualise that components other than those of hemicellulose could contribute to the discolouration.

In the after-yellowing of raw jute, however, it is important that the role of the hemicelluloses should not be over-emphasised. The light-yellow colouration obtained during irradiation of delignified jute is quite distinct in appearance from the yellow-brown colour obtained with raw jute and indicates that in the latter case the ligneous portion makes the greater contribution to the discolouration reactions.

The major portion of the yellow-brown colour derivatives can be extracted from irradiated jute with water or alcohol, and the aqueous extract, for example, shows that quininoid reaction products are formed. These, no doubt, are derived from the ligneous portion of the jute, since the formation of quininoid derivatives from this portion of the lignocellulosic materials is well established. There is a loss of methoxyl content in lignin during irradiation of jute. Phenolic substances capable of being transformed to the coloured quininoid type are therefore held to give rise to those coloured products derived from the ligneous portion. Degradation of the hemicellulose portion with the prior formation of furfural and subsequent conversion of the aldehyde to coloured polymers is believed to be the contribution of the hemicelluloses to the discolouration.

Preliminary reports[1,2,3,4] show that progress has been achieved towards inhibition of the colour changes. Inhibition of the photochemi-

cal changes can be brought about in raw jute by certain esterification and etherification treatments, among which acetylation gives complete protection, whereas methylation with an ethereal solution of diazomethane affords only partial protection. After these treatments it is probable that substituted polyphenols which are incapable of quinone formation are produced during irradiation. The introduction of acetyl groups has the two-fold effect of preventing the formation of coloured quinones and causing the production of a bleaching agent during irradiation. Methylation, on the other hand, duly prevents quinone formation, but does not repress any discolouration due to aldehydic polymerisation. Furthermore, it has been noted that the colour obtained during irradiation of methylated jute resembles the yellow colour which results from the accelerated ageing of delignified jute.

Meanwhile, Sarkar and his colleagues[1] have shown that delignified jute does not discolour if immersed in ethyl alcohol. The mechanism of this inhibition reaction, stated by the authors to consist of the preferential oxidation of the alcohol is rendered untenable in view of the fact that, as shown above, the presence of oxygen is not necessary for the formation of coloured derivatives. Preferential absorption of the particular wave-band responsible for the discolouration reactions, by such an applied substance is, however, more likely to lead to success. Initial removal of potential colour-producing substances and replacement by an artificial resin may be possible.

Dept. of Textile Industries,
The University,
Leeds, H. J. CALLOW.
(Indian Jute Mills Association
Research Institute),
August 11, 1947.

1. Sarkar, Chatterjee, Mazumdar and Nodder, *Curr. Sci.*, 1947, **16**, 74. 2. Lewis and Fronmuller, *Paper Trade J.*, 1945, **121**, *Tappi Sect.*, 133. 3. Atkins and Callow, Provisional B. P. 22366/46. 4. Peill, *Nature*, 1946, **158**, 554. 5. Callow, *Ibid.*, 1947, **159**, 309.

YELLOWING OF BLEACHED JUTE—FURTHER OBSERVATIONS

DISCOLOURATION of raw jute and yellowing of the fully bleached fibre on exposure to light or on storage may not be due to the same changes in so far as the role played by the hemicelluloses alone is concerned, for the hemicelluloses in the raw fibre are not, in all probability, identically the same as those in delignified jute. Apart from oxidative changes (jute holocellulose prepared with sodium chlorite dissolves appreciably in very dilute NaOH solution at room temperature with a yellow colour) there is the cleavage of a chemical bond between lignin and polyuronide hemicelluloses (some recent observations in these laboratories appear to confirm this). Our note in *Current Science*[1] was exclusively on the yellowing of fully bleached jute; so I must confine my remarks to this problem only. We have observed that delignified jute turns appreciably yellow even when stored in the dark (in thick glass tubes covered several times with black paper) though to a slightly lesser extent than in diffused light. The changes leading to yellowing of bleached jute on storage does not, therefore, appear to be exclusively photochemical.

Since the publication of the note, further important observations have been made in this regard which necessitate modification of a view expressed therein. Delignified jute stored under benzene has been observed to turn yellow to the same extent as that kept under alcohol containing a little water. Since aqueous alcohol cannot prevent the yellowing of bleached jute as absolute alcohol does, our explanation on the basis of preferential oxidation, offered earlier, does not stand. Some agent other than oxygen is possibly responsible for the yellowing; this apparently supports the view of Mr. Callow expressed in the foregoing note.

But the following observations would indicate that the presence of moisture in the delignified fibre is essential for the development of yellow colour on storage. (i) A sample kept over fused calcium chloride in an ordinary desiccator for more than a year has not turned yellow as yet. Another sample placed over conc. H_2SO_4 in an ordinary desiccator has turned very slightly brownish. (ii) A similar sample, stored over saturated NH_4Cl solution in a vacuum desiccator turned yellow just like the control, exposed to air. In view of these facts, the protection afforded by absolute alcohol would seem to be due to its dehydrating nature. Further experiments are in progress.

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August 30, 1947.

1. Sarkar, *et al.*, *Curr. Sci.*, 1947, **16**, 74.

SOME NEW CHEMICAL AGENTS FOR CONTROL OF RABBIT COCCIDIOSIS

COCCIDIOSIS is a common cause of mortality both in poultry and rabbits. In the latter, *Eimeria stiedæ* (Lindemann) and *E. perforans* (Leuckert) are discharged as unsporulated oöcysts by chronic carriers. *E. stiedæ* attacks the liver and causes unusual hypertrophy of the organ owing to the proliferation of biliary epithelium and bile ducts.[1] *E. perforans*, on the other hand, causes acute enteritis. Mixed infections by both the parasites resulting in very quick death of the host are not uncommon. Reports of successful attempts of control of coccidiosis in rabbits with sulfasuxidine and pthalylsulfathiazole have recently been made.[2,3] The result of trials conducted by the author with 14 chemical agents for destroying the rabbit coccidian oöcysts *in vitro* are given in Table I.

Fresh, washed, unsegmented oöcysts from the liver and intestine of infected rabbits were suspended for 24 hours in sporulating dishes containing each of the reagents. At the end

of the period the number of oöcysts that were dead and alive out of 300 were counted, the live ones containing bright, compact zygotes and the dead ones having macerated zygotes and distorted walls.

TABLE I

Mortality percentages of the oöcysts of E. stiedæ *and* E. perforans *when treated with different chemical agents*

Reagent	Strength of Solution %	Mortality percentages	
		E. stiedæ	*E. perforans*
Carbolic acid ..	2	58	18
Copper sulphate	10	10	12
Caustic soda ..	2	10	15
Formal ..	5	15	10
Mercuric chloride	1	25	20
Mono-chlor-oxylenol	9	100	100
Sulphosalycilic acid	10	15	10
Hydrochloric acid	2	40	12
Terpineol ..	3	100	100
Iodine ..	2	60	75
Picric acid ..	Saturated Solution	10	12
Potassium per-manganate	2	10	40
Phenol ..	15	16	18
Sodium salycilate	2	8	5

The table shows that 5 per cent. terpineol and 9 per cent. monochloroxylenol are the most effective in destroying the oöcysts.

In a case of outbreak of coccidiosis in a rabbit colony the spreading of the disease can be checked by: (1) removal of the infected animals either by death or isolation, (2) therapeutic measures and (3) preventing the access of parasites to the uninfected animals by killing the oöcysts. The present findings, therefore, open up the possibility of using 3 per cent. terpineol or 9 per cent. monochloroxylenol effectively for the latter purpose.

I wish to thank Dr. J. G. Carr of the Institute of Animal Genetics for placing the infected rabbits of his experimental colony at my disposal.

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Poultry Husbandry,
Section of Animal Genetics,
Ithaca, New York),
December 20, 1946.

1. Janklewicz. H. A., *J. Parasit.*, 1945, **31**, 18. 2. —, *Ibid.*, 15. 3. Lund, E. E., *Ibid.*, 11.

EXTRACTION OF VISCERAL OIL FROM INLAND WATER FISHES IN THE COLLAIR LAKE AREA, MADRAS[1]

THE pyloric cæca, intestine and fat bodies of many fishes contain a good quantity of oil, indicating the distribution of vitamin A in these organs.

The extraction of oil from the viscera of the following species of inland water fishes is a cottage industry around the Collair Lake: (*a*) *Macrones gulio* (Ham.), (*b*) *M. cavasius* (Ham.), (*c*) fingerlings of *Labeo fumbriatus* (Bloch.), (*d*) fingerlings of *L. calbasu* (Ham.), (*e*) *Cirrhina reba* (Ham.), (*f*) *Barbus sarana* (Ham.), (*g*) *B. sophore* Hamilton, and (*h*) *B. ticto* (Ham.). The fish, after the removal of the viscera, are salted and dried, and exported to the Ceded Districts and to the Mysore State.

The viscera are treated with water in flat mud pots over a slow and steady fire. After about one half hour the boiling viscera are slightly stirred and pressed with a wooden ladle. The dark-yellow oil is then filtered through cloth and stored in mud vessels (yield, 20 per cent.) About 10,000 pounds of oil are thus extracted annually in this area.

The following is the analysis of the gut contents which are not removed from the viscera utilised for oil extraction:

(*a*) *Macrones gulio*: *Copepods, Fragillaria, Pleurosigma, Barbus* spp., fish-eggs, fish-scales, larval worms, *Oryzias melastigma*, prawns, and sand particles.

(*b*) *M. cavasius*: Appendages of crabs, insect remains and mud.

(*c*) *Labeo fimbriatus*: *Closterium, Copepods, Coscinidiscus, Cyclotella*, daphnids, *Fragillaria*, insect remains, *Navicula* and sand particles.

(*d*) *L. calbasu*: *Caridina* sp., *Chætomorpha, Closterium*, Copepods, *Cosmarium*, Cypris, Daphnid, insect larvæ, *Lyngbia*, Mysids, *Oscillatoria, Pandorina*, Rotifers, *Spirogyra, Synedra*, and sand particles.

(*e*) *Cirrhina reba*: *Oscillatoria, Lyngbia* and *Rhizoclonium*; and daphnids, insect larvæ, *Navicula, Pinnularia*, Rotifers, *Tabellaria*, and mud.

(*f*) *Barbus sarana*: Eunotia, fish-scales, *Fragillaria*, insect remains, *Mastogloia, Navicula, Nitschia, Pinularia* and sand grains.

(*g*) *B. sophore*: Algal filaments, *Bacillaria, Coscinodiscus, Cosmaria, Cyclotella, Eræmosphæra, Fragillaria, Gomphonema, Melosira, Navicula, Nitzschia, Pediastrum, Surirella, Stauroneris, Tabellaria*, Volvox and sand particles.

(*h*) *B. ticto*: *Anabæna, Bacillaria*, copepods, *Cyclotella*, daphnids, *Eunotia, Fragillaria*, insect remains, insect larvæ, *Mastogloia, Navicula, Nitzschia, Pinnularia, Spirogyra, Tabellaria* and sand grains.

Vitamin A potency of the oil varied from 50 to 330 International Units per gram, with an acid value of 31·4.* Though the presence of vitamin A enhances the food value of the oil, it is mainly used for lighting as a substitute for kerosine. 10 c.c. of the oil keeps a cotton wick burning for three hours. The residue from oil extraction is dried and used as poultry food. The large-scale exploitation of these

species of fishes for their visceral oil may be economically justifiable.

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Kilpauk, Madras, P. I. CHACKO.
June 1947..

1. Read before the Zoology Section at the 33rd Indian Science Congress, 1946, and communicated by permission of the Director of Industries and Commerce, Madras. 2. Jowett, W. G., and Davies, W., *A Chemical Study of Some Australian Fish*, 1938.

* This analysis was conducted in the Nutrition Research Laboratories, Coonoor, and in the Government Oil Factory, Calicut.

SQUILLA HIEROGLYPHICA KEMP.

MR. KURIYAN'S note on the occurrence of *Squilla hieroglyphica* along the Travancore coast is indeed of considerable interest in view of the fact that the present record extends the range of this rare Indo-Pacific Stomatopod to the west coast of India also. However, his surmise that the species does not appear to have been recorded since Kemp's original description is not quite correct. Kemp[2] himself collected a second specimen from the Philippines in 1915. It was a female, 48 mm. long. The third record of the species was from the Madras coast. The present writer[3] collected an *Alima* in the final pelagic stage from the Madras plankton, reared it in the laboratory through metamorphosis and identified the post-larva as *S. hieroglyphica*. Not only has the species thus been recorded from the Indian waters, but its pelagic larva has also been described and figured. The close resemblance of this Indo-Pacific species to *S. hildebrandi* recently described by Schmitt[4] from the Panama Canal zone was also pointed out by the writer.

The specimen recorded from Travancore is, therefore, the fourth known so far, and it would appear that the species is not altogether so very rare in the Indo-Pacific region.

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Government Fisheries,
Madras, K. H. ALIKUNHI.
July 10, 1947.

1. Kuriyan, C. V., *Curr. Sci.*, 1947, **16**, 124. 2. Kemp, S., *Philippine J. Sci.*, (D), 1915, **10**, 1. Alikunhi, K. H., *Curr. Sci.*, 1944, **13**, 18. 4. Schmitt, W. L., *Rept. Allan Hancock Pacific Exped.*, 1940, **5**, 4.

THE MIGRATORY FISHES OF THE INLAND WATERS OF MADRAS

IN accordance with the resolution of the Advisory Board of the Indian Council of Agricultural Research for a survey of the fishery resources of water-ways, a preliminary survey of the migratory fishes of the Madras Province was conducted by me. The following are the salient features of this survey.

The four major rivers in the Madras Presidency, namely, the Godavari, the Kistna, the Tungabhadra and the Cauvery, are generally in floods from June to December, when they are characterised by muddy discolouration, great velocity of flow and fluctuating depth. By the end of January the river recedes, and these rivers soon dwindle into a few scattered pools which may be interconnected by narrow strips of shallow water until the next year's floods raise the levels again.

It is found that first freshets stimulate the migratory impulse in the various species; and with the rise, swell and discharge of the mingled waters the migration is soon in full swing. The migratory fishes in the rivers of Madras can be grouped into four classes, namely, those (1) entering the rivers from the sea, (2) descending the rivers into the sea, (3) moving up and down the upper reaches, and (4) showing local migrations in the plains.

The Hilsa, *Hilsa ilisha* (Ham.), is one of the most commercially important fishes, ascending the rivers for feeding and breeding. In the Godavari alone this fish yields an annual fishery worth about Rs. 100 lakhs, and in the Kistna and the Cauvery it contributes substantially to the bulk of the riverine crop. Under existing conditions of these South Indian rivers the Hilsa exhibits the longest migration. In the Godavari, it has been observed to go upwards to a distance of 210 miles from the sea, *i.e.*, up to the Dummagudem Anicut. The Bekti, *Lates calcarifer* (Bloch.), the Jew Fish, *Sciæna belangeri* (C. & V.), and the Mullet, *Mugil olivaceus* Day, ascend the rivers, particularly the Godavari and Kistna, in fairly large numbers, to a limit of 80 miles from the sea. Thus, specimens of these species were caught from Polavaram and Bezwada. Stray specimens of the Tarpon, *Megalops cyprinoides* (Broussonet), the marine glass fish, *Ambassis commersonii*, C. & V., and of the Indian Salmon, *Polynemus tetradactylus* Shaw, were observed up to the Godavari Anicut, about 60 miles from the sea. Gonadial examination has not revealed that these species migrate far into the river for spawning. It is presumed that they ascend the rivers only for feeding.

The freshwater eel, *Anguilla bengalensis* (Ham.), which migrates from freshwater to the sea for spawning, is but poorly represented in the rivers and other waters of Madras.

The species which move up and down the upper reaches of the rivers for breeding and feeding are (1) the Carnatic Carp, *Barbus carnaticus, Jerdon.*, (2) the Brown Mahseer, *B. hexagonolepis*, McClell, (3) the Mahseer, *B. tor*, (Ham.), and (4) the Goonch, *Bagarius yarrelli* (Ham.). The Mahseer has been observed to breed in the upper reaches of the Cauvery, Bhavani, Tungabhadra and Godavari; and the Carnatic Carp and the Brown Mahseer in the upper reaches of the Cauvery. The Goonch breeds in the Tungabhadra.

The species which show local migrations in the plains are chiefly (1) *Wallago attu* (Bl. Schn.), (2) *Callichrous bimaculatus* (Bl.), (3) *Pangasius pangasius* (Ham.), (4) *Silundia silundia* (Ham.), (5) *Marcones aor* (Ham.), (6) *M. seenghala* (Sykes), (7) *Labeo fimbriatus* (Bloch.), (8) *L. calbasu* (Ham.), (9) *Cirrhina cirrhosa* (Bl.), (10) *C. reba*, Ham., (11) *Catla catla* (Ham.), (12) *Thynnichthys sandkhol* (Sykes), (13) *Barbus sarana* (Ham.), and (14) *B. dubius* (Day).

Large numbers of berried individuals of four species of prawns, namely, *Palæmon malcolmsonii* H. Milne-Edwars., *P. scabriculus Heller.*, *Penæus indicus* Milne-Edwars., and *Metapenæus monoceros* (Fabr.) (kindly identified by Dr. B. N. Chopra, Zoological Survey of India), occur in the Godavari river both above and below the anicut, and contribute to a prawn fishery, indicating thereby that these shell fishes breed in the river during the flood season. The occurrence of *Penæus indicus* in the river to a distance of 100 miles from the sea is of special significance, as various workers have stated that this specie breeds only in the inshore sea or in bays and estuaries. A fairly good percentage of the shoals of *Palæmon malcolmsonii* was found infested by the Bopyrid parasite, *Pelægyge alcocki* Chopra.[1]

The measures adopted by the Madras Fisheries for the development of the river fisheries are: (1) conservancy operations to a distance of one mile below all dams and anicuts, and below the Hogainakkal Falls in the upper reaches of the Cauvery, (2) protection of immature fish in the upper reaches of the Bhavani and Moyar rivers, (3) observation of a close season for Hilsa for a stretch of one mile below the first anicut across the Godavari, Kistna and Coleroon, (4) protective legislation against the destruction of immature carps in the canal system of the Kistna river, and (5) artificial propagation of Hilsa in a hatchery at Bobberlanka in the Godavari delta.

The future existence and development of the fluviale fisheries of our country depend not only on the ability of the adult migratory fishes to perpetuate themselves but also on the ability of the young to complete its larval and post-larval development and to be successfully distributed into favourable environments and attain commercial size. Artificial and natural barriers prevent the fishes from reaching all the natural spawning grounds which should be available to them. Continuance of such obstructions might in course of time lead to the disappearance of the fish even from the lower waters of the river. Detailed investigations regarding the suitability and efficiency of fish passes with reference to local topography and hydrography, and leaping capacity, migratory habits and preferences of the species concerned remain to be pursued by fishery workers in collaboration with the personnel in charge of irrigation and hydro-electric projects. Hora[2] has recently outlined a plan of work for this investigation.

I am thankful to Dr. T. J. Job, Deputy Director of Fisheries, Madras, for his suggestions during my survey work.

Inland Fisheries Office,
Kilpauk, Madras, P. I. CHACKO.
July 1947.

* This note has been communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Chopra, B. N., *Rec. Ind. Mus.*, 1923, **25**, 495.
2. Hora, S. L., *Cent. Board. Irri.*, 1947, **4**, 10.

DEGENERATIONS IN *LEUCAENA GLAUCA*, BENTH.

IN Mimosaceæ sterility had been observed in several species, but it is only in *Albizzia lebbek*[1] and *Acacia Baileyana*[2,3,4] that degenerations have been studied in some detail. In *Leucæna glauca*, degenerations have been observed both in the anthers and ovules.

In this plant it was observed by the author that degenerations during microsporogenesis occur at a comparatively early stage. In some microsporangia only a few microspore mother-cells underwent division, ultimately giving rise to the tetrads of spores, the rest of microspore mother-cells failing to show the slightest indication of division. The figure represents an interesting case in which both the microspores and undivided microspore

mother-cells were seen in the same microsporangium. As a consequence, very few pollen grains developed in each of such microsporangia.

A feature of interest in the embryology of *Leucæna glauca* and directly connected with the degenerations of the microspore mother-cells was in regard to the tapetum. This, as the figure shows, instead of being a continuous layer completely surrounding the microsporangium, developed only in contact with the functioning microspore mother-cells and did not extend around the non-functioning microspore mother-cells. The explanation of the peculiar tapetum is obvious. It developed to nourish the dividing microspore mother-cells and the resultant microspores, and it did not show any development where the microspore mother-cells had stopped functioning.

Further, it may be noted that in the lower part of the microsporangium, the parietal layer did not show any periclinal division, there being thus no endothecium or middle layer which were, however, clearly differentiated in the upper part.

Degenerations in the ovules were found to occur at any stage after the formation of megaspores, but they were more common after the four-nucleate stage of the embryo-sac involving any of the nuclei of the sac.

Detailed account will be published elsewhere. The author is grateful to Prof. R. L. Nirula for valuable help, suggestions and criticisms.

Department of Botany,
College of Science, V. R. DNYANSAGAR.
Nagpur,
August 28, 1947.

1. Maheshwari, P., *J. Indian Bot. Soc.*, 1931, **10**, 241. 2. Newman, I. V., *J. Linn. Soc. (Bot.)*, 1933, **49**, 147. 3 —, *Proc. Linn. Soc. New South Wales*, 1934, **59**, 237. 4. —, *Ibid.*, 1934, **59**, 297.

SEEDLING BLIGHT OF SAFFLOWER *CARTHAMUS TINCTORIUS* L.

THIS disease was first observed during April 1947 among potted safflower seedlings about six weeks old grown for experimental purposes. Incidence of the disease was high during cloudy days when the temperature fell below 25° C., and losses amounted to over 75 per cent., sometimes being as high as 90 to 95 per cent. The most common mode of infection was in the terminal bud or in young leaves, starting as a small brown water-soaked lesion which spread rapidly involving the entire plant in a decay characterised by the water-soaked and shrunken appearance of the affected portions (Fig. 1). Death usually resulted in 12 to 15 days. Infection starting at the collar region from where the rot spread upwards, soon involving the entire plant was also seen in some cases.

Isolations made with surface-sterilized bits of diseased tissue consistently yielded pure growths of a *Phytophthora* which was later identified as *P. palmivora* Butler, a species common in South India. The pathogenicity of the fungus was proved repeatedly by isolation and inoculation (Fig. 2). High level of humidity favoured rapid spread of the disease.

FIG. 1. Seedlings of *Carthamus tinctorius* L. showing various stages of infection: *A*. Totally blighted seedling; B. Healthy seedling; *C*. Seedling showing die-back of the younger portions.

The fungus grew well on most agar-media, producing luxuriant aerial mycelia. Spherical or limoniform sporangia and sub-spherical to spherical chlamydospores were also produced in abundance, the sizes of these structures agreeing with those given by other workers for this species. As, however, the fungus did not produce any oöspores in pure culture even after three months, attempts were made to induce oöspore formation by growing it in paired cultures with known plus and minus strains of *P. palmivora* available in the Government Mycologist's stock culture collection at Coimbatore. The isolate from safflower formed oöspores in 7 to 10 days when grown with plus strains from *Areca catechu* L. (Bombay), *Cyphomandra betacea* Sendt. (Burliar, Nilghiris), *Lycopersicum esculentum* Mill. (Coimbatore) and *Colocasia antiquorum* Schott. (South Kanara), while it did not form any oöspores even after one month when grown with minus strains isolated from *Hibiscus esculentus* L. (Coimbatore), *Carica papaya* L. (Coimbatore), *Hevea brasilensis* Muell. (Travancore) and *Areca catechu* L. (Bombay), thereby showing that it is a minus strain of *P. palmivora*. No

FIG. 2. Blighted (A) and healthy (B) seedlings Photograph taken ten days after inoculation.

species of *Phytophthora* appears to have been recorded on this host so far.

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Mycology Section,
Agric. Research Institute,
Coimbatore, S. India,
September 4, 1947.

THE RUST OF SAFFLOWER *PUCCINIA CARTHAMI* (HUTZ.) CORDA

THE rust which infects the leaves of safflower, *Carthamus tinctorius* L. (Fig. 1), is quite common in Peninsular India and has been observed year after year in this Institute in the month of March. Its life-history has not been studied in this country, and nothing is known of its annual recurrence. There is no record in literature to show if the germination of its teleutospores has been observed anywhere. Conners and Savile[1] demonstrated experimentally that it is a brachy-form rust with a tendency towards short-cycling, and obtained evidence of the teleutospores on the seed infecting the young crop in Canada. It appears, however, that they did not observe the germination of teleutospores on the slide, and nothing is known of the influence of environmental conditions on their germination. The writer was able to get successful results which are reported here.

FIG. 1. A rusted leaf of safflower

The appearance of uredo sori of the rust was observed on the crop in this Institute on 22nd March 1947, and teleutospores were formed in the same sori a fortnight later. Some leaves bearing the teleuto stage were collected and soaked overnight in tap water. The teleutospores were then spread out on a thin film of water on glass slides and put for germination in moist chambers at 5°-7°, 12°-14°, 18°, 26° and 30°-35° C. (room temperature). After three days germination was observed only at 12°-14° and 18° C.; germination was 25 and 60 per cent. respectively.

A culture of the rust was established in the uredo stage on safflower seedlings in the laboratory. The same results were obtained when teleutospores from these pot cultures were kept for germination at different temperatures mentioned above.

On germination both cells of the teleutospores produce stout, four-celled promycelium and from each cell of the latter a basidiospore develops on a short sterigma (Fig. 2). The basidiospore germinates *in situ* giving rise to a thin and short wavy germ tube (Fig. 3).

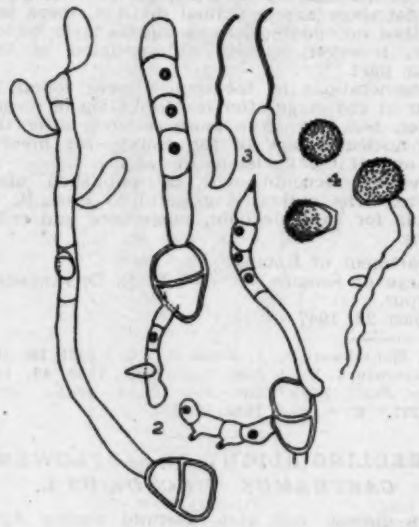

FIG. 2. Germinating teleutospores ×250.
FIG. 3. Germinating basidiospores ×250.
FIG. 4. Uredospores; one germinating. ×250.

Germination of fresh uredospores taken from pot cultures was found to be copious between 12°-26° C. with optimum near 18° C. No germination was observed at 5°-7° C. and only traces of it at room temperature (30°-35° C.) (Fig. 4).

Further studies are in progress.

Division of Mycology and
Plant Pathology, RAGHUBIR PRASADA.
Indian Agricultural Research
Institute, New Delhi,
June 10, 1947.

1. Conners, I. L., and Savile, D. B. O. 23rd Ann. Rep. of the Canadian Plant Disease Survey, 1943, *Ibid.*, 28, 1944.

ON THE FACILITIES FOR PRACTICAL TRAINING IN FOREIGN COUNTRIES

I WRITE this in view of the prominence you have given in your July 1947 issue, to the matter of the difficulties experienced by Indian students for getting admitted into works and factories abroad.

What else do you expect? Factories and works all over the world are not philanthropic institutions to distribute their experience gratis.

It is recognised by every one including the sponsors of the wholesale technical foreign scholarships, that the entire scheme is futile. Prof. A. V. Hill declared that one way of paying off sterling balances was by the institution of these scholarships, and it certainly fulfils this.

Works and factories will welcome aspirants if they stand to gain some benefit themselves. If you undertake to buy their product or plant in substantial quantity, then you can not only get welcomed but even insist on the training of as many scholars as you wish. There is the well-known instance of the Persian (present Iranian) Government enforcing the training of its nationals in petrol technology in return for oil concessions to the powerful Oil Companies.

One member of the Scholarship Committee declared that a big electrical concern suggested that rather than send single individual scholars to their works, it would be more profitable to send a team of a dozen or a score of men who will be put through the activities of their whole organisation. It appears this excellent scheme was turned down by the Government of India at the time.

Why should it not be adopted now? I would also like to ask how many industrial concerns in India will offer to train scholars gratis. It is in the experience of many of us that even visitors are discouraged in most of them.

It will be a good thing if the future Government made a statutory rule, that every industry in India should give training to suitable candidates, on payment of a premium or in some other form which may be determined. The huge amount of money now spent aimlessly abroad, may then be usefully diverted inside the country, and to better purpose.

Uttarpara P.O.,
Dt. Hooghly, M. RAJAGOPALAN.
Bengal,
August 8, 1947.

ENCOURAGEMENT OF SCIENTIFIC TALENT IN THE COUNTRY

IN a recent issue of *Current Science*,* Sir T. S. Venkataraman has drawn pointed attention to want of proper recognition and encouragement of scientific talent in the country. Coming from a person of his standing and experience, his advice is entitled to much respect.

One of the well-known defects of scientific investigators in the country is the tendency to take up a number of scientific problems, generally beyond the scope of a single individual to tackle. There is very little of intense specialization, which is so characteristic of leading foreign laboratories and which, as in the case of Sir Venkataraman himself, can lead to outstanding achievement. The author of this note is himself a big sinner in this respect. This fissiparous tendency, as Dr. G. J. Fowler has often described it, is not always the result of one's own choice. The problems are often thrust on the people concerned and one's confirmation or promotion would depend on the number of enquiries 'disposed off' in the course of a year. The Head of an important laboratory once complained that he was expected to deal with fresh problems at the rate of one, and often two, per week! In research laboratories, selection of different lines of work is often the result of a combination of factors—the need for additional financial assistance which could be obtained only on the basis of different programmes of research; and provision of encouragement for and even subsequent employment of the associated research students. In Europe and America, it is not uncommon to find one trained in protein chemistry taken up by the petroleum industry. In India, unless a person is associated, at least in a small way, with a particular line, he has no scope for employment in that line. That is due to the very limited opportunities for employment in the country.

It is not always that a scientist willingly gives up active research to take up an administrative position. Contributions to science do not always count in life, and a senior worker in India may find that, even after several years of good work, he remains in the same position and draws the same emoluments, while his own needs and commitments go on increasing. He sees no scope for advancement under such conditions and has soon to make up his mind between continuing in the same position or securing an administrative position with higher emoluments, better status and power of patronage.

If the scientific man-power committee is to function effectively, it should first work out a procedure for finding scientific talent, wherever it may exist in the country. An obvious method will be to maintain a register or card-index relating to all the scientific workers. This will not, by itself, reveal much, as most of the information will have to come from the worker himself who is an interested party. Confidential notes from heads of institutions and departments may be more helpful, but they may not always be unbiased. An alternative will be to have a permanent commission consisting of quite senior people of high scientific standing who would tour the country and visit all the scientific laboratories and other institutions at least once a year. They would then be able to come into direct contact with various workers and form first-hand impressions about them. The commission could then make its own recommendations to the Government as to how the most promising people could be best utilised by the State. There would naturally be greater stimulus to effort and achievement if the young scientists are aware that, in addition to their immediate superiors, there is also a big national organisation watching over them; that they have scope

for unlimited encouragement if they can show themselves worthy of it.

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Bangalore, V. SUBRAHMANYAN.
August 2, 1947.

* *Curr. Sci.*, June 1947.

THE FOOD VALUE OF TWO COMMON MOLLUSCS FOUND NEAR PAMBAN AND THE CHEMICAL COMPOSITION OF THEIR SHELLS*

Two varieties of molluscs, Turban shells (*Turbo margaritaceus*) and wedge shells (*Donax cuncatus*) occur on the shores of the Madras Presidency, and their flesh are commonly eaten by fisherfolk when other sea-fish are not available.

TABLE I
Analyses of Mollusc in Madras

Local name (Tamil)	Scientific name	Edibility %	Average size	H_2O %	Proteins %	Fat %	Ash %	P_2O_5 %	CaO %	Iron mgm. 100 gm.
Nathai ..	*Turbo margaritaceus* (Turban shells)	25	3×2 cm.	74·78	17·59	0·25	4·72	0·55	2·69	31·83
Vazhi matti	*Donax cuneatus* (wedge shells)	25	2×1 cm.	76·45	13·13	0·99	4·84	0·40	2·65	32·0

Data on the food value of these edible molluscs are given here. The edible flesh of the molluscs from the shores of the Krusadai Island, were analysed according to A.O.A.C. methods.[1] Phosphorus (Ammonium Molybdate Volumetric method), Calcium (McCrudden's Permanganate method), and Iron (Elvehjem-Kennedy method), were also estimated.

The figures show that these molluscs compare in food value very favourably with fish, and are richer in Ca and Fe, though somewhat poorer in P. We, therefore, feel that there is sufficient justification for popularising these molluscs as food as good as fish.

The shells of molluscs are sometimes used for making quicklime. An analysis of the shells of these molluscs are given in Table II.

TABLE II
Composition of Shells of Molluscs in Madras
(per cent.)

Particulars	H_2O	Lime as $CaCO_3$	SO_3	Insolubles	Organic matter
Shells of *Turbo* ..	1·00	93·02	0·11	0·237	5·98
Shells of *Donax* ..	0·54	94·83	1·32	0·161	3·17

The high $CaCO_3$ content provides the main sources of a high quality lime. The crushed shells may be utilised as poultry feed because of its high calcium content.

Fisheries Section,
Dept. of Industries and Commerce,
West-Hill, Madras, S. T. CHARI.
March 24, 1947. M. MUKUNDAN UNNY.

* Published with the kind permission of the Director of Industries and Commerce Madras.

1. Methods of Analysis, by the Association of Official Agricultural Chemists, 1945—Washington.

INTERNATIONAL PHARMACEUTICAL FEDERATION

THE General Assembly of the International Pharmaceutical Federation was held at Zurich on the 25th, 26th and 27th of August 1947. About 250 delegates from various countries attended. The President of the Federation, Dr. Madsen (Copenhagen), presided.

The activities of the first day included the business meeting of the Bureau of the Federation and a meeting of the Directors of Drug Control Laboratories. On the second day, after the Presidential Address by Dr. Madsen, certain matters of special interest to Pharmacy such as International Methods for the Analysis of Pharmaceutical Specialities, were discussed. A proposition to start a new International pharmaceutical periodical the aim of which was "to publish for international information articles which had previously been published in national periodicals only" aroused great interest and discussion. The reason for this proposition was stated to be that "the scientific workers of smaller countries have been at a disadvantage because their publications only reached a limited circle". As an argument against the proposition it was contended that well-established journals would be unwilling to allow their publications to be reproduced. No final decision was taken on this question at the Conference.

Scientific papers that were read and discussed included one on "Some Alkaloid-glycosides", by Dr. Caspari, one on "Local Anæsthetics", by Prof. Büchi, on "Saponins", by Dr. Ruyssen, on "The Polarographic Determination of Morphine", by Dr. Rasmussen, and on "Aromatic Drugs", by Dr. Girardet.

Visits to the Pharmaceutical Department of the E.T.H., Zurich, the Pharmacy of the Zurich Cantonal Hospital and to the laboratories and factories of Ciba, Roche, Sandoz and Geigy at Basel on the 29th constituted other scientific activities, while the social side was catered for by a banquet on the 27th night and an excursion to the Swiss Alps on the 28th.

The Indian Pharmaceutical Association was represented at the Assembly by Dr. S. Rangaswami and Mr. S. B. Rao.

S. RANGASWAMI.

REVIEWS

Infrared and Raman Spectra of Polyatomic Molecules. By Gerhard Herzberg. (D. Van Nostrand Company Inc., New York), 1946. Pp. xiv + 632. Price 50 *sh.*

Prof. Herzberg, whose investigations in the field of molecular spectra are well known, has planned a trilogy dealing with the entire field, and the present book is the second in the series, the first being *Molecular Spectra and Molecular Structure I: Diatomic Molecules* (Prentice Hall, New York, 1939). A further volume on *Electronic Spectra and Electronic Structure of Polyatomic Molecules* is promised. When added to his *Atomic Spectra and Atomic Structure* (Dover Publications, New York, 1944), the series will form an exhaustive source of information on atomic and molecular spectra.

The subject is dealt with in an authoritative and detailed manner characteristic of German scholarship at its best, and the presentation is lucid and illuminating, with numerous illustrations in the best American tradition. The appearance of the book is most opportune since the subject of the spectra of polyatomic molecules is just at that stage where after much spadework by pioneers, a rapid development is being achieved by an increasing army of workers. There is a dearth of completely satisfactory accounts of the field and Prof. Herzberg's books supply the want in an eminently suitable manner. An enthusiastic welcome is, therefore, certain to be received. We can only add that such a welcome is highly deserved. His book on the spectra of diatomic molecules has already become the standard text in the field, and there is no doubt that the present book will take a similar place. We shall, therefore, give an indication of the contents of this work.

After a preliminary chapter dealing with symmetry elements and symmetry operations, the book begins with the theory of rotation spectra taking linear, symmetric top, spherical top and asymmetric top molecules in turn. The next chapter deals with the classical and wave-mechanical treatment of normal vibrations, anharmonicity and isotope effect in great detail. The theory is illustrated by the consideration of infra-red and Raman vibration spectra in the next chapter which also includes a detailed discussion of the spectra of particular molecules. Rotation-vibration spectra, dealt with in the fourth chapter, are particularly well illustrated with photographs, this field being illuminated by the researches of the author and his co-workers. A final chapter on applications includes sections on the calculation of thermodynamic quantities and the nature of liquid and solid states. The discussion in this last section is so inviting that one regrets that Prof. Herzberg has not added his critical appraisement of a number of researches whose results were somewhat of a controversial character; but possibly a book is not the best place to deal with controversial matters.

Although there are some very good books dealing with Raman Spectra, the author's presentation gains in value by the sure touch of a teacher's instinct with which Prof. Herzberg has chosen the best treatment and the thorough manner in which classical theory and its wave-mechanical modification and improvement are consistently blended from the beginning to the end of the book. The number of diagrams and tables is large—we may say lavish—even by American standards. The immense material surveyed, digested and critically served up for the reader's edification can be gauged by the list of 29 books and 1,055 original papers given in the bibliography, and the subject index running to 65 pages makes all this material available for selection at a moment's notice. The book thus provides immense help and counsel to anyone who wants to get acquainted with this rather intricate and difficult field. The appreciation here attempted is a result of a sense of having had an urgent want well supplied and a conviction that a similar sense of thankfulness is bound to arise in the mind of every reader who turns to this book for instruction and guidance. Prof. Herzberg can very well have the satisfaction of having completed a particularly useful and difficult task in a manner calculated to earn the gratitude of a large number of readers. The fame of the publishers is a guarantee to the excellence of the typography and binding, although the present reprint has had to eschew the use of the best paper on account of war economy. The book is an indispensable addition and ornament to the library of every spectroscopist and an inexhaustible mine of information to every research worker in this subject. We extend to it a hearty welcome and eagerly look forward to the promised volume which is to complete the trilogy.

T. S. SUBBARAYA.

Fundamental Principles and Applications of Induction Heating. *"Heat Treater"*, (Chapman and Hall, Ltd.), 1947. Pp. 145. 10*s.* 6*d.*

High frequency induction furnaces have from their inception rendered important assistance to scientific investigators handling high purity metallic products at temperatures beyond the reach of more conventional furnaces. Commercially, high frequency induction melting has been used to a limited extent in the production of valuable materials such as permalloy and nickel-chromium alloys. During the past few years, however, much attention has been directed, to the use of high ferquency induction (or eddy) currents for the heat-treatment of fabricated or partly fabricated products.

In his book, *Fundamental Principles and Applications of Induction Heating*, the author is concerned mainly with the thermal treatment of solid materials. Ordinary melting operations are outside the scope of this book although some processes are described in which localised melting is conducted under strictly controlled conditions. After a very brief histori-

cal introduction to the subject of high frequency induction heating, reference is made to some of its modern applications which are quickly, cheaply, conveniently conducted and result in a better product. The distinction is drawn between induction and dielectric heating. The author emphasises that a full mathematical treatment is omitted and that the simplified formulæ given in the book should only be used as a basis for coil design. It is evident to the reviewer that caution is necessary in the use of the equation (page 28) which indicates that the power dissipated in the surface layers of a specimen—varies as the square root of the resistivity. In the extreme case this leads to the absurdity that the maximum amount of heat would be generated by induction in an insulating or semi-insulating material. Further, the formula ignores the reactance of the eddy current circuit. Mathematical treatment is difficult because electrical resistivity, thermal conductivity, specific heat and possibly magnetic permeability change during the process of heating. It is, therefore, not surprising that the author states that final details for a particular heating operation are invariably determined by trial and error.

Many interesting drawings are given, depicting single and multi-turn inductor coils intended for heating special zones of variously shaped metallic specimens. The process can be applied to the interior surfaces of hollow samples. The choice of frequency (for the current in the inductor coil) is discussed, and although not critical, due regard must be given to the size of the sample and the desired thickness (or penetration) of the heated zone. This is followed by a brief review of the three types of generators commonly in use—namely, motor generators, spark gap generators and thermionic valve oscillators.

It is considered by the reviewer that a little attention should be given to this section of the book in order to bring the whole work to a uniformly excellent standard. For example an ordinary commercial step-up transformer cannot be used in the spark gap generator, as stated by the author (page 52), unless chokes are provided. Again in Fig. 34 the secondary winding of the step-up transformer is shown metallically connected to the heating coil. It is easy and customary to isolate the heating or operating coil from high voltages at mains frequency by interposing condenser units. The function of the induction coil in this diagram is mysterious. What is probably intended is some form of step-down transformer intended to feed the operating coil with heavy currents at low voltage.

Regarding valve oscillators, the two sample oscillators shown in Figs. 37 and 38 are hardly suitable for commercial operation since in both cases the magnitude of the oscillations depend greatly on the loading of the operating coil. Thus, it is possible in some instances to completely suppress the oscillations by inserting ferromagnetic material into the field of the oscillating coil. One remedy is to construct an oscillator comprising a master oscillator driving the power valve which supplies the energy for the operating coil.

The largest section of the book is devoted to the hardening of steel by induction heating and quenching. Often quite localised hardening is required, and this must be done with the minimum distortion to the specimen. Induction heating, owing to its ease of control, is peculiarly suited for this operation. Further, it is claimed that harder wearing surfaces are obtained by inductive heating and quenching than by other methods. Of the many examples given, two may be mentioned. A localised hard bearing surface can readily be produced on the inside cylindrical surface of motor car wheel hub. Gear wheel teeth can be surface-hardened leaving the interior of the teeth and the body of the wheel in a moderately soft and tough condition. Induction heating is not only suitable for repetition work involving surface-hardening but can also be applied economically to welding (including carbide tops on tools) brazing and soldering processes. Notable among the miscellaneous applications is the flowing of electro-deposited tin coatings. This permits a saving in tin since a more uniform and less porous layer of tin is produced. It is impossible in a few words to do justice to the latter portion of the book which presents in a convenient form a mass of information much of which has appeared from time to time —scattered—in various recent publications.

The writer is undoubtedly an expert in the practical application of induction heating and his authoritative book is indispensable to anyone interested in this rapidly expanding art.

FRANK ADCOCK.

The Chemical Constitution of Natural Fats. By T. P. Hilditch. (Chapman and Hall, Ltd., London), 1947. Second Edition. Pp. 554. Price 45 *sh.* net.

Fats form a very important class of organic compounds both from industrial and nutritional point of view. A systematic examination of their chemical composition may be said to have begun with the present century. On account of the complexity of composition of fats, the chemist at one time was content with the determination of a few constants. It is only as a result of painstaking work and new techniques evolved during the last decade it has been possible to determine the detailed composition of such a complex group of substances with relative ease, thus enabling us not only to study them but also predict their composition with a reasonable degree of accuracy having known their origin. This achievement is in no small measure due to the inspiring and untiring work of Prof. T. P. Hilditch and his colleagues at the University of Liverpool, which has now become an international centre for research on fats and allied subjects.

The second edition of the book under review has appeared within a period of seven years, and considering the present conditions in Great Britain, under which this must have been compiled, the author and the publishers deserve to be congratulated. The book is a unique contribution to our knowledge of chemistry of natural fats, and all the more valuable as it is written by one who has made the study of fats his life-work. This new edition, like its predecessor, has been divided into eleven chapters, and almost every page has been revised to bring

our knowledge up to date. The book contains extensive bibliography and is well indexed. The law of even distribution of fatty acids in glyceride molecules has been explained in detail and applied with success to predict the composition of fats of the same group. Notable new additions include composition of the body-fats of marine teleostid fish; component acids of depot fats of rats on low and high fat diets; composition of depot glycerides of Indian ox and buffalo and the effect of climatic conditions; composition of the body-fats of lion, puma, tiger, cat, baboon and man; component acids of blood lipids. The chapter on milk fats has been revised to include data on the effect of food, season and species on its composition. Further data on different seed fats, detailed description of the technique for the separation of mixed fatty acids by crystallisation at low temperatures, and computation of proportion of the chief component glycerides of a fat from its fatty acid composition, have also been added.

Throughout the book the position of the unsaturated linkage has been denoted by reference to the first C atom, instead of both (i.e., oleic acid as C^9 instead of $C^{9\ 10}$) as is the usual practice to-day. This conveys the required meaning without any ambiguity, saves space and is more pleasant to read. One minor correction may be pointed out. On page 112 the Reichert Value has been described as Reichert-Meissl Value in spite of the recommendation in the B.S.S. No. 769-1938. The range of variation of the Reichert Value of cow butter-fat should be more appropriately 23-36.

NOSHIR N. DASTUR.

The First Brochure of the Chronicle of the World Health Organisation, Geneva, 1947 (Vol. 1, No. 1).

The Journal under review is one that deals with the aims, the constitution and functions of the Organisation.

This Organisation though of recent inception has taken upon itself a very laudable but supremely tremendous task of viewing health problems from international standpoint. It is very rightly stated that 'disease knows no frontiers, and anything less than world action may not only deprive one nation of the benefits of the Organisation, but may endanger the health of all member States'.

The activities of the Organisation are 'various, widespread and complex'. 'They affect not only governments and public health administrators but practitioners in many fields of medicine and hence certain aspects of the lives of individual citizens. . The declaration contained in the preamble to its constitution, *viz.*, 'the enjoyment of the highest attainable *standard* of health is one of the fundamental rights of every human being' is its ultimate goal. The concept of health is wide and comprehensive. The Organisation rightly holds that 'health is a state of *complete* physical, mental and social well-being and not merely the absence of disease or infirmity'. Besides it holds that 'the health of all peoples is fundamental to the attainment of *peace and security*'. (Both these, alas! being totally shattered by the Great War and its aftermath.)

The Organisation proposes to achieve its object by (1) co-operation, (2) co-ordination, (3) propaganda, (4) dissemination of comparative statistical records, discussions, suggestions and topics of interest by publication of leaflets and brochures apart from the *Chronicle of W.H.O.*, (5) research work, (6) finansial aid, (7) conventions and (8) expert advice.

To us particularly, in Independent India, this effort ought to be very welcome indeed. For, too long have we suffered from ill-health, misery and bondage, too long have the poor ratepayers' moneys gone elsewhere and utilised for purposes other than the amelioration of living conditions of the mass of people, too long have we borne patiently all these, and now free India should certainly brace up and consider the health of the people of the nation as its first charge. In this connection the World Health Organisation is bound to be of immeasurable help. It is to be earnestly hoped that India will wholeheartedly co-operate and reap the full benefit. At present the offices of the Organisation are at 350, Fifth Avenue, New York.

K. R. RAMASWAMY.

The Relation of Diseases in the Lower Animals to Human Welfare. (*Annals of the New York Academy of Sciences*, Vol. 48), 1947. Pp. 226.

This is a symposium which embodies nine excellent papers presented at a conference on the subject, held by the Section of Biology of the New York Academy of Sciences, on March 15 and 16, 1946. The subjects dealt with, *viz.*, rabies, equine encephalomyelitis, psittacosis, brucellosis, plague, tuberculosis, anthrax, *Erysipelothrix rhusiopathiæ* infection and animal parasites transmissable to man vitally concern human welfare and have been handled by experts who have devoted considerable study and thought to the respective branch of study. Up-to-date information has been given on each subject, with a masterly historical perspective. The volume is heralded with an apt introduction by Dr. W. A. Hagan who attempted to bring home to the public the enormous loss caused by various parasites in the United States of America and indicated the manner in which these could be transmitted from lower animals to man. The publication of this number has fulfilled a long-felt want of collated information on several important subjects, and it will be useful to the people belonging to the medical profession, to veterinarians, public health workers and students of biology in general.

G. D. BHALERAO.

PUBLICATIONS RECEIVED

1. *All Necessary Water can be Synthesized within the Plants.* By Nandlal Sharma, Ex-Principal and Research Scholar, P.O. Khamgaon (Berar).

2. *Bihar's Mineral Wealth and Industries.* By W. D. West. (A popular lecture delivered on the occasion of the First Anniversary of the Geology Department, Patna University, on April 25, 1947.)

Carnegie Institution of Washington—Year-Book, No. 45, 1945-46.

SCIENCE NOTES AND NEWS

Research Grants

A meeting of the Governing Body of the Council of Industrial and Scientific Research was held at New Delhi on August 25. Pandit Jawaharlal Nehru, Prime Minister of India, presided.

The Council sanctioned schemes of research involving a total expenditure of Rs. 83,700.

It was decided to establish a National Internal Combustion Engineering Laboratory, and to send abroad fifteen students for advanced study and training in internal combustion engineering in order to meet the needs of the National Laboratory, Industries and Technological Institutes.

The Council also recommended a grant of Rs. 2·25 lakhs to the Indian Institute of Science, Bangalore, for the training of personnel in internal combustion engines and for long-range research in the field. The setting up of an Indian Aircraft Establishment, and Admiralty Establishment and an Internal Combustion Engine Development Board was recommended by the Council.

The Council decided to bring out a monograph on Indian medicinal plants and a popular edition of the monograph on aromatic plants of India.

A grant of Rs. 3 lakhs was sanctioned for the Research Institute of the Indian Academy of Sciences, Bangalore, for physical and chemical investigations of the minerals of India under the direction of Sir C. V. Raman.

Dr. Shyamaprasad Mookherjee was elected Vice-President of the Council.

Indian Institute of Science

The Council of the Indian Institute of Science approved, at a meeting on the 8th September, a large building programme for housing laboratories of power engineering, high-voltage engineering, pharmacology, fermentation technology and food technology.

The Council also recommended to the Visitor the appointment of Dr. B. Sanjiva Rao to the post of Nizam Professor of Inorganic and Mineral Chemistry at the Institute.

Unesco Projects for India

It is reported that in the very near future UNESCO will undertake publication of scientific journals in Indian languages, probably from Calcutta, for the purpose of disseminating the results of the latest scientific research from all parts of the world to the Indian public. To begin with, the Journals will come out in Bengali and Hindi, and later it may be published in other Indian languages.

Some of the Most Important Advances in Science in 1946

Science Service of Washington, D. C., lists (1) Distribution of radioactive isotope varieties of common chemical elements, made in chain-reacting atomic pile, for research and medical use; (2) Synthesis of penicillin and of vitamin A; (3) Revelation of biological warfare developments, including vaccine against rinderpest, and isolation of botulinus toxin; (4) Production of anti-malarials, chloroquin, declared better than atabrine and quinine, and pentaquine, believed positive cure for vivax malaria; (5) First births of animals from foster-mothers into which were transplanted ovaries from other animals.

Substitute for Jute

The South African Government has announced that all details for the cultivation of "wilde stokroos" (wild hollyhock) and the establishment of South Africa's first factory for manufacture of bags from fibre has been settled.

Wilde stokroos will be planted in the low veld of the Transvaal for the time being. Nelspruit has been chosen as the site of the factory.

Records of the Indian Museum

The Records of the Indian Museum, a Journal of Indian Zoology, which was suspended in 1942, was received last year, and Part IV of Volume XLIV appeared in December 1946. The next issue is expected to be published shortly. The Journal will be a quarterly as hithertofore.

A Reaper for Indian Farms

Mr. R. Venkata Ramaiah, a scholar deputed to the Iowa State College for specialisation in Agricultural Engineering, has devised a mechanical reaper of simple construction suitable for use on small holdings in India. The design can be built in Indian workshops at a cost of about Rs. 300, and is capable of reaping 4½ to 6 acres in a ten-hour day.

Sir C. V. Raman

The World Bank Advisory Council has recommended that nine persons representing various international industrial, scientific and agricultural organisations be selected to form the Advisory Council of the Bank to serve as Councillors for a period of two years. They have included Sir C. V. Raman of India, and S. K. Alfred Sze of China.

Dr. S. R. Palit

Dr. S. R. Palit has been elected Fellow of the Royal Institute of Chemistry of Great Britain and Ireland on the merit of his published researches.

ERRATA

Vol. 16, No. 7, July 1947, p. 225: "Formation of Complex Compounds ..." Under References on p. 226, *omit* "Mathur".

Vol. 16, No. 8, August 1947, p. 257: *Read* Fig. 1 as Fig. 2 and *vice versa*.

Same page: In second column, para 3, *read* (Fig. 2) at the end of the sentence "The accompanying figure will give an idea of the distribution of *Fusarium* during different months of the year."

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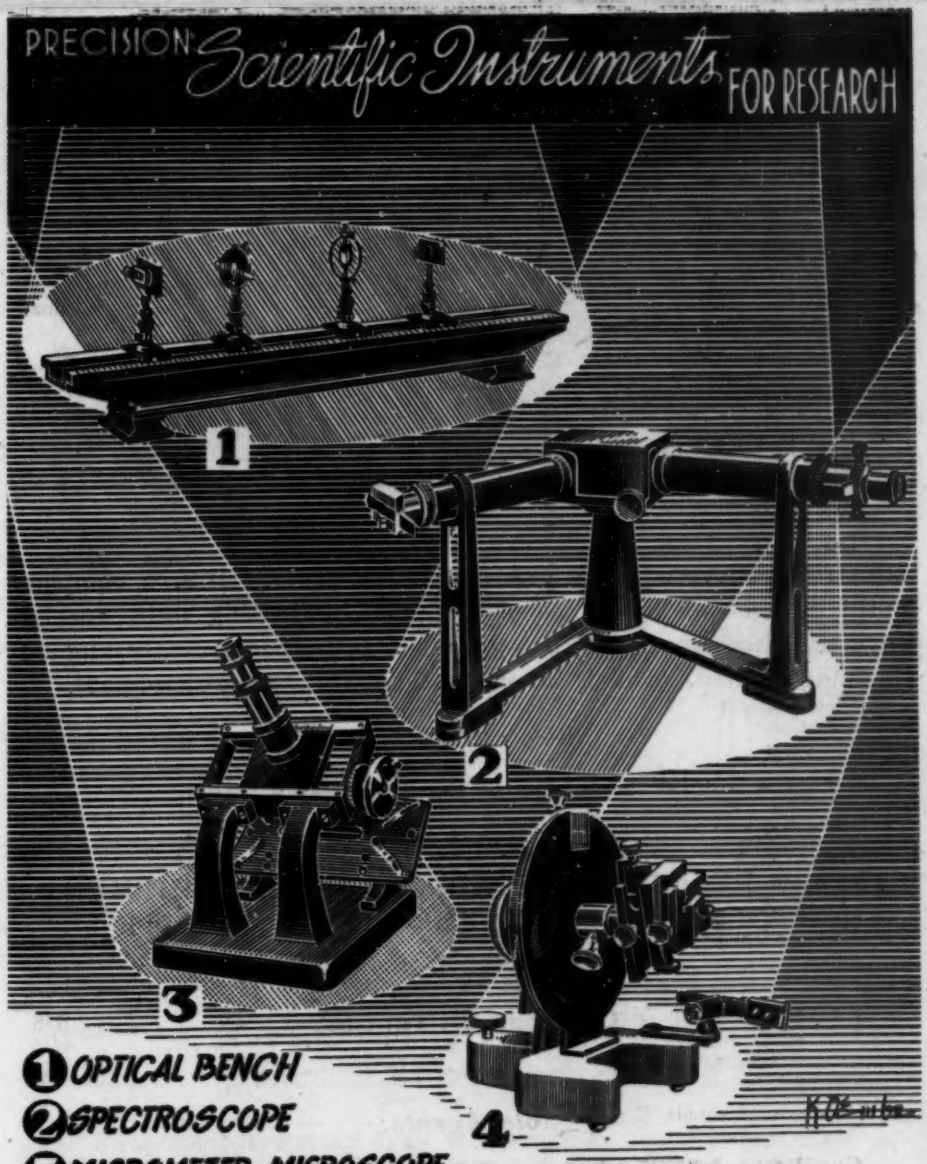

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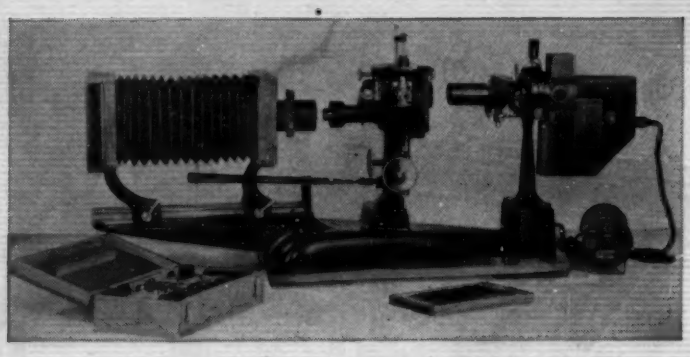

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